REMARKS/ARGUMENTS

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Respectfully submitted,
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DESCRIPTION

INFORMATION-PROCESSING DEVICE, SERVER, COMMUNICATION SYSTEM, ADDRESS DECISION METHOD, ADDRESS MODIFICATION METHOD, AND PROGRAM

TECHNICAL FIELD

The present invention relates to a communication system, in particular, to one that performs tunnel communication.

BACKGROUND ART

Conventionally, tunnel communication, in which target data are encapsulated for communication, has been developed. Such technology is disclosed in Japanese Patent Laid-Open Application No. 2003-244188 (the first and other pages, and the third and other figures).

In tunnel communication, communication target data to be encapsulated also needs its IP address to be set by an information-processing device as a communication terminal. The IP address must be set so as not to overlap among each information-processing terminal. Meanwhile, methods of allocating an address include DHCP and AutoIP.

However, an address allocation method with DHCP, AutoIP or the like uses a heuristic algorithm. In AutoIP, for instance, an address range is set in advance and the following processes are repeated: an information-processing device at the client inquires at the server if a given IP address is available or not. If the address is not being used

by another information-processing device, the address is used; otherwise, the device further inquires if still another address is available or not.   This heuristic algorithm is complicated and has problems in that it takes a long time to determine an IP address to be

5   used by an information-processing device at the client.   Further, an IP address within a predetermined range is allocated by the client's information-processing device so as not to overlap, and thus the device is unable to allocate too many addresses to exceed a predetermined address range.

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SUMMARY OF THE INVENTION

The present invention, in order to solve the above-mentioned problems, aims at providing a communication system and the like that determine an IP address to be used for communication target data

15   encapsulated in tunnel communication, with a simple algorithm.

In order to achieve the above-mentioned objective, an information-processing device according to the present invention is an information-processing device for communication source that performs tunnel communication with a device for communication destination,

20   where the information-processing device is equipped with: a tunnel communication part that encapsulates communication target data to perform tunnel communication; an identifier acceptor for accepting a communication destination device identifier for identifying a device at the communication destination; an identifier storage part that stores a

25   communication   source   device   identifier   for   identifying   the information-processing device; and an address determination part for determining an address to be used for the communication target data,

according to the communication destination device identifier and the communication source device identifier.

With such a makeup, an address to be used for communication target data in tunnel communication can be determined according to a

5   communication destination device identifier and a communication source device identifier, with a simple algorithm. Consequently, an address does not need to be determined with DHCP or AutoIP, both using a heuristic algorithm, thus dispensing with a DHCP server and the like in a communication system.

10   An information-processing device according to the present invention is an information-processing device for communication source, that performs tunnel communication with a device for communication destination, where the information-processing device is equipped with: a tunnel communication part that performs the tunnel

15   communication with communication target data encapsulated; a ~~judgement~~ <u>judgment</u> part for judging whether the information-processing device is a caller or callee in the tunnel communication; and an address determination part for determining an address to be used for the communication target data, according to a

20   determination by the ~~judgement~~ <u>judgment</u> part.

With such a makeup, an address to be used for communication target data in tunnel communication can be determined with a simple algorithm, according to a determination that the information-processing device is a caller or callee. Consequently, an

25   address does not need to be determined with DHCP or AutoIP, both using a heuristic algorithm, thus dispensing with a DHCP server and the like in a communication system.

An information-processing device according to the present invention is an information-processing device for communication source, that performs tunnel communication with a device for communication destination, where the information-processing device is

5   equipped with: a tunnel communication part that performs the tunnel communication with communication target data encapsulated; an identifier acceptor for accepting a communication destination device identifier for identifying a device at the communication destination; an identifier storage part that stores a communication source device

10   identifier for identifying the information-processing device; a tunnel communication identifier acceptor for accepting a tunnel communication identifier for identifying the tunnel communication; and an address determination part for determining an address to be used for the communication target data, according to the

15   communication destination device identifier, to the communication source device identifier, and to the tunnel communication identifier.

With such a makeup, an address to be used for communication target data in tunnel communication can be determined with a simple algorithm, according to a communication destination device identifier,

20   to a communication source device identifier, and to a tunnel communication identifier.   Consequently, an address does not need to be determined with DHCP or AutoIP, both using a heuristic algorithm, thus dispensing with a DHCP server and the like in a communication system.

25   An information-processing device according to the present invention is an information-processing device for communication source, that performs tunnel communication with a device for

communication destination, where the information-processing device is equipped with: a tunnel communication part that performs the tunnel communication with communication target data encapsulated; a ~~judgement~~ <u>judgment</u> part for judging whether the

5   information-processing device is a caller or callee in the tunnel communication; a tunnel communication identifier acceptor for accepting a tunnel communication identifier for identifying the tunnel communication; and an address determination part for determining an address to be used for the communication target data, according to a

10   determination by the ~~judgement~~ <u>judgment</u> part and the tunnel communication identifier.

       With such a makeup, an address to be used for communication target data in tunnel communication can be determined with a simple algorithm, according to a determination that the

15   information-processing device is a caller or callee, and to a tunnel communication identifier.   Consequently, an address does not need to be determined with DHCP or AutoIP, both using a heuristic algorithm, thus dispensing with a DHCP server and the like in a communication system.

20   A server according to the present invention is equipped with: an identifier acceptor for accepting a first device identifier for identifying a first information-processing device, and a second device identifier for identifying a second information-processing device; an address determination part for determining a first address of the first

25   information-processing device and a second address of the second information-processing device, both used for communication target data encapsulated in tunnel communication performed between the

first information-processing device and the second
information-processing device, according to the first device identifier
and the second device identifier, both accepted by the identifier
acceptor; and an address output part for outputting the first address

5   and the second address that the address determination part has
determined.

With such a makeup, an address to be used for communication
target data in tunnel communication can be determined with a simple
algorithm, according to a first device identifier and a second device

10   identifier.   Consequently, an address does not need to be determined
with DHCP or AutoIP, both using a heuristic algorithm, thus
dispensing with a DHCP server and the like in a communication
system.

A server according to the present invention is equipped with: a

15   ~~judgement~~ judgment part for judging which is a caller or callee, the
first information-processing device or second information-processing
device in tunnel communication; an address determination part for
determining a first address of the first information-processing device
and a second address of the second information-processing device, both

20   used for communication target data encapsulated in tunnel
communication performed between the first information-processing
device and the second information-processing device, according to a
determination by the ~~judgement~~ judgment part; and an address output
part for outputting the first address and the second address that the

25   address determination part has determined.

With such a makeup, an address to be used for communication
target data in tunnel communication can be determined with a simple

algorithm, according to a determination that the first
information-processing device or second information-processing device
is a caller or callee.   Consequently, an address does not need to be
determined with DHCP or AutoIP, both using a heuristic algorithm,

5   thus dispensing with a DHCP server and the like in a communication
system.

A server according to the present invention is equipped with: an
identifier acceptor for accepting a first device identifier for identifying
a first information-processing device, and a second device identifier for

10   identifying a second information-processing device; a tunnel
communication identifier acceptor for accepting a tunnel
communication identifier for identifying tunnel communication
performed between the first information-processing device and the
second information-processing device; an address determination part

15   for determining a first address of the first information-processing
device and a second address of the second information-processing
device, both used for communication target data encapsulated in
tunnel communication performed between the first
information-processing device and the second information-processing

20   device, according to the first device identifier and the second device
identifier, both accepted by the identifier acceptor, and a tunnel
communication identifier accepted by the tunnel communication
identifier acceptor; and an address output part for outputting the first
address and the second address that the address determination part

25   has determined.

With such a makeup, an address to be used for communication
target data in tunnel communication can be determined with a simple

algorithm, according to a first device identifier, to a second device identifier, and to a tunnel communication identifier.   Consequently, an address does not need to be determined with DHCP or AutoIP, both using a heuristic algorithm, thus dispensing with a DHCP server and

5   the like in a communication system.

A server according to the present invention is equipped with: a ~~judgement~~ <u>judgment</u> part for judging which is a caller or callee, the first information-processing device or second information-processing device in tunnel communication; a tunnel communication identifier

10   acceptor for accepting a tunnel communication identifier for identifying tunnel communication performed between the first information-processing device and the second information-processing device; an address determination part for determining a first address of the first information-processing device and a second address of the

15   second information-processing device, both used for communication target data encapsulated in tunnel communication performed between the first information-processing device and the second information-processing device, according to a determination by the ~~judgement~~ <u>judgment</u> part and a tunnel communication identifier

20   accepted by the tunnel communication identifier acceptor; and an address output part for outputting the first address and the second address that the address determination part has determined.

With such a makeup, an address to be used for communication target data in tunnel communication can be determined with a simple

25   algorithm, according to a determination that the first information-processing device or second information-processing device is a caller or callee, and to the tunnel communication identifier.

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Consequently, an address does not need to be determined with DHCP or AutoIP, both using a heuristic algorithm, thus dispensing with a DHCP server and the like in a communication system.

A server according to the present invention is equipped with: an address agreement information receiver for receiving address agreement information showing that two or more addresses ~~agree~~ are the same that are used for communication target data encapsulated in two or more tunnel communications; an address change information composition part for composing address change information that is related to address change, so as to resolve the address agreement; an address change information transmitter for transmitting the address change information.

With such a makeup, if it is detected in two or more tunnel communications that two or more addresses used for communication target data ~~agree~~are the same, the two or more addresses can be resolved by composing and transmitting address change information.

In this way, an information-processing device and others according to the present invention allow an address used for communication target data encapsulated in tunnel communication to be determined with a simple method.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows the makeup of a communication system according to embodiment 1 of the present invention.

Fig. 2 is a block diagram showing the makeup of a first information-processing device according to the embodiment.

Fig. 3 is a block diagram showing the makeup of a second

information-processing device according to the embodiment.

Fig. 4 is a flowchart showing the action of the first information-processing device in the embodiment.

Fig. 5A shows a data structure in the embodiment.

5   Fig. 5B shows a data structure in the embodiment.

Fig. 6 shows a table that is an example of correspondence between a digit number of a device in the embodiment and an IP address.

Fig. 7 shows the makeup of a first information-processing device according to embodiment 2 of the present invention.

10   Fig. 8 shows the makeup of a second information-processing device according to the 2nd embodiment.

Fig. 9 shows the makeup of a communication system according to embodiment 3 of the present invention.

Fig. 10 is a flowchart showing the action of a server in the 3rd

15   embodiment.

Fig. 11 shows an example of correspondence between a device identifier in the 3rd embodiment and an IP address.

Fig. 12 is a block diagram showing the makeup of a first information-processing device according to embodiment 4 of the

20   present invention.

Fig. 13 is a block diagram showing the makeup of a second information-processing device according to the 4th embodiment.

Fig. 14 is a flowchart showing the action of a first information-processing device in the 4th embodiment.

25   Fig. 15A shows a table that is an example of correspondence between a caller and a callee in the 4th embodiment, and an IP address.

Fig. 15B shows a table that is an example of correspondence

between a caller and a callee in the 4<u>th</u> embodiment, and an IP address.

Fig. 16 shows the makeup of a communication system according to embodiment 5 of the present invention.

Fig. 17 shows the makeup of a communication system according to embodiment 6 of the present invention.

Fig. 18 is a flowchart showing the action of a server in the 6<u>th</u> embodiment.

Fig. 19 is a block diagram showing the makeup of a first information-processing device according to embodiment 7 of the present invention.

Fig. 20 is a block diagram showing the makeup of a server according to the 7<u>th</u> embodiment.

Fig. 21 is a flowchart showing the action of a first information-processing device in the 7<u>th</u> embodiment.

Fig. 22A shows an example of the makeup of an address in the 7<u>th</u> embodiment.

Fig. 22B shows a table that is an example of correspondence between a digit number of a device identifier in the 7<u>th</u> embodiment and an IP address.

Fig. 23 shows the makeup of a communication system according to embodiment 8 of the present invention.

Fig. 24 shows the makeup of a communication system according to embodiment 9 of the present invention.

Fig. 25 is a flowchart showing the action of a server in the 9<u>th</u> embodiment.

Fig. 26 is a block diagram showing the makeup of a first information-processing device according to embodiment 10 of the

present invention.

Fig. 27 is a flowchart showing the action of a first information-processing device in the 10th embodiment.

Fig. 28A shows an example of the makeup of an address in the 10th

5   embodiment.

Fig. 28B shows a table that is an example of correspondence between a caller or callee and a host address in the 10th embodiment.

Fig. 28C shows a table that is an example of correspondence between a caller or callee and a host address in the 10th embodiment.

10   Fig. 29 shows the makeup of a communication system according to embodiment 11 of the present invention.

Fig. 30 shows the makeup of a communication system according to embodiment 12 of the present invention.

Fig. 31 is a flowchart showing the action of a server in the 12th

15   embodiment.

Fig. 32 shows the makeup of a communication system according to embodiment 13 of the present invention.

Fig. 33 is a block diagram showing the makeup of a first information-processing device according to the 13th embodiment.

20   Fig. 34 is a block diagram showing the makeup of a third information-processing device according to the 13th embodiment.

Fig. 35 is a flowchart showing the action of a first information-processing device in the 13th embodiment.

Fig. 36 is a block diagram showing the makeup of a first

25   information-processing device according to embodiment 14 of the present invention.

Fig. 37 is a block diagram showing the makeup of a second

information-processing device according to the 14th embodiment.

Fig. 38 is a flowchart showing the action of a first information-processing device in the 14th embodiment.

Fig. 39 is a flowchart showing the action of a second information-processing device in the 14th embodiment.

Fig. 40 is a block diagram showing the makeup of a first information-processing device according to embodiment 15 of the present invention.

Fig. 41 is a block diagram showing the makeup of a second information-processing device according to the 15th embodiment.

Fig. 42 is a block diagram showing the makeup of a server according to the 15th embodiment.

Fig. 43 is a flowchart showing the action of a server in the 15th embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

(Embodiment 1)

A description is made for a communication system according to embodiment 1 of the present invention, referring to drawings.

Fig. 1 shows the makeup of a communication system according to the embodiment.   In Fig. 1, the communication system according to the embodiment is provided with: a first information-processing device 1, a second information-processing device 2, and a server 4, all connected to one another via a wired or wireless communication line 3. Communication line 3 is the Internet, for example.   In this embodiment, an address used for communication target data being encapsulated in tunnel communication is to be determined by first

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information-processing device 1.

    Fig. 2 is a block diagram showing the makeup of <u>the</u> first information-processing device 1.   In Fig. 2, <u>the</u> first information-processing device 1 is equipped with <u>a</u> tunnel

5   communication part 11, an identifier acceptor 12, <u>an</u> identifier storage part 13, <u>an</u> address determination part 14, and <u>an</u> address transmitter 15.

    Tunnel communication part 11 performs tunnel communication between <u>the</u> first information-processing device 1 and <u>the </u>second

10   information-processing device 2.   Here, <u>the</u> tunnel communication refers to communication performed with <u>encapsulated</u> communication target data ~~encapsulated~~.   Tunnel communication part 11 performs actions such as encapsulation of communication target data, and release of a capsule for transmitted encapsulated data ~~having been~~

15   ~~transmitted~~.   Encapsulation refers to encompassing communication target data with a header or the like prescribed by a protocol. Communication target data to be encapsulated may be optionally encrypted.   Examples for tunnel communication include UDP tunnel communication, HTTP tunnel communication, and L2TP tunnel

20   communication.   Here, <u>the</u> tunnel communication part 11 may optionally include a communication device (e.g. modem and network card).

    In this case, a communication device (not illustrated) may exist between <u>the</u> tunnel communication part 11 and <u>the</u> communication line

25   3, or software for passing data to the communication device may exist. Tunnel communication part 11 may be implemented with hardware, or software such as a driver for driving the communication device.

Further, the tunnel communication part 11 may acquire

communication target data, for example, by reading from a given

recording medium (e.g. DVD and hard disk), or it may acquire

communication target data by accepting data transmitted or input

5   from a given device.

Identifier acceptor 12 accepts a communication destination device

identifier for identifying a destination device for a communication

destination, namely the second information-processing device 2.   Here,

the identifier acceptor 12 may accept a communication destination

10   device identifier having been input from an input device (e.g. keyboard,

mouse, or touch panel), it may accept a communication destination

device identifier having been transmitted via a wired or wireless

communication lines, or it may accept a communication destination

device identifier having been read from a given recording medium (e.g.

15   optical disc, magnetic disk, or semiconductor memory).

Identifier storage part 13 stores a communication source device

identifier for identifying a source device for a communication source,

namely the first information-processing device 1.   Here, the identifier

storage part 13 can be implemented with a given recording medium (e.g.

20   semiconductor memory, magnetic disk, or optical disc).   Storage in the

identifier storage part 13 may be utilize a temporary storage device

such as a RAM indicated by a communication source device identifier

read from an external storage device, for example, or may utilize a

long-term storage device such as a ROM.

25   In this embodiment, the first information-processing device 1 is

regarded as a communication source, with the first

information-processing device 1 as the reference device, and the second

information-processing device 2 ~~is~~ regarded as [[a]] <u>the</u> communication

destination.   Therefore, the device identifier for identifying <u>the</u> first

information-processing device 1 is referred to as a communication

source device identifier, while the device identifier for identifying <u>the</u>

5   second information-processing device 2 is referred to as a

communication destination device identifier.   However, [[a]] <u>the</u>

communication destination and [[a]] <u>the</u> communication source are

expediential, and thus both may be swapped if, for example, <u>the</u> second

information-processing device 2 is the reference device.   For instance,

10   [[a]] <u>the</u> device identifier for identifying [[a]] <u>the</u> first

information-processing device may be referred to as [[a]] <u>the</u>

communication destination device identifier.

In addition, the communication destination device identifier and

communication source device identifier are different <u>from</u> each other,

15   and <u>a</u> GUID (global unique ID) such as a MAC address or EUI64-based

address may be used.

Address determination part 14 determines an address (sometimes

called <u>a</u> "virtual interface address" or <u>a</u> "tunnel mode address") used

for communication target data encapsulated in <u>the</u> tunnel

20   communication, according to [[a]] <u>the</u> communication destination

device identifier accepted by identifier acceptor 12, and to [[a]] <u>the</u>

communication source device identifier stored in <u>the</u> identifier storage

part 13.   It is sufficient if the address<u>es</u> used for [[a]] <u>the destination</u>

device for communication destination (namely, <u>the</u> second

25   information-processing device 2) and [[a]] <u>the</u> device for <u>the</u>

communication source (namely, <u>the</u> first information-processing device

1) are determined so that they are different each other, according to the

communication destination device identifier and <u>the</u> communication source device identifier.   Methods of determining an address include one ~~with~~ <u>using</u> a given function ~~used~~, and one ~~by~~ selecting from a plurality of predetermined addresses.   The latter method includes one

5   ~~with~~ <u>using</u> a given table ~~used~~, and one that compares [[a]] <u>the</u> communication destination device identifier with [[a]] <u>the</u> communication source device identifier, and <u>determining the address</u> ~~determines~~ according to the comparison result.   A concrete example of a method of determining an address is described hereinafter.   In

10 determining addresses, ~~an~~ <u>the</u> address<u>es</u> for a device for communication source and/or <u>the</u> one for communication destination may be determined.   In this embodiment, a description is <u>provided</u> ~~made~~ for a case where both addresses for [[a]] <u>the</u> communication source and <u>the</u> communication destination are determined.

15   Address transmitter 15 transmits an address determined at <u>the</u> address determination part 14.   This transmitting may be made either to <u>the</u> second information-processing device 2, to <u>the</u> server 4, or to another device administrating addresses.   If the transmitting is performed to <u>the</u> server 4 or the like, the address may be passed from

20 <u>the</u> server 4 or the like to <u>the</u> second information-processing device 2, directly (by transmitting, for example), or indirectly (by transmitting via another server or recording medium, for example).   A target address to be transmitted may be only the address for [[a]] <u>the destination</u> device for communication destination (namely, <u>the</u> second

25 information-processing device 2), or may include ~~the~~ one for ~~a~~ <u>the</u> communication source (namely, <u>the</u> first information-processing device 1).   Still, <u>the</u> address transmitter 15 may optionally include a

transmission device (e.g. modem and network card).   In this case, [[a]]
the communication device (not illustrated) may exist between the
address transmitter 15 and the communication line 3, or software or
the like for passing data to the communication device may exist.

5   Address transmitter 15 may be implemented with hardware, or
software such as a driver for driving the transmission device.

Fig. 3 is a block diagram showing the makeup of the second
information-processing device 2.   In Fig. 3, the second
information-processing device 2 is equipped with an address acceptor

10   21, a tunnel communication part 22, and an identifier storage part 23.
Address acceptor 21 accepts an address used for the communication
target data in tunnel communication.   Address acceptor 21, for
example, may accept an address having been input from an input
device (e.g. keyboard, mouse, or touch panel), may accept an address

15   transmitted through wired or wireless communication lines, or may
accept an address having been read from a given recording medium (e.g.
optical disc, magnetic disk, or semiconductor memory).   In this
embodiment, an the address transmitted from the first
information-processing device 1 is to be accepted.

20   Tunnel communication part 22 performs tunnel communication
with the first information-processing device 1.   In the tunnel
communication, an address accepted by the address acceptor 21 is used
as an the address used for the communication target data.   The other
makeup is the same as that of the tunnel communication part 11, and

25   thus its description is omitted.

Identifier storage part 23 stores [[a]] the communication
destination device identifier for identifying [[a]] the destination device

for communication destination, namely the second information-processing device 2.   Here, the identifier storage part 23 is the same as the identifier storage part 13 in the first information-processing device 1, except that it stores [[a]] the

5   communication destination device identifier instead of [[a]] the communication source device identifier, and thus its description is omitted.

       Server 4 performs processes related to establishing tunnel communication between the first information-processing device 1 and

10   the second information-processing device 2.   One such example is that the server 4 notifies the first information-processing device 1 of the address of the second information-processing device 2.

       Next, a description is made for the action of a communication system, in particular the action for determining an address by the first

15   information-processing device 1, according to this embodiment.   Fig. 4 is a flowchart showing the action for determining an the address in first information-processing device 1.

       (S101) Identifier acceptor 12 judges determines whether a communication destination device identifier has been accepted or not.

20   If accepted, the process passes the communication destination device identifier to the address determination part 14, and then the flow goes to S102; otherwise, the action of S101 is repeated.

       (S102) Address determination part 14 determines an the address used for communication target data in the tunnel communication,

25   according to [[a]] the communication source device identifier stored in the identifier storage part 13, and according to [[a]] the communication destination device identifier accepted by the identifier acceptor 12, and

then passes the determined address to <u>the</u> tunnel communication part

11 and <u>the</u> address transmitter 15.

(S103) Address transmitter 15 transmits ~~an~~ <u>the</u> address

determined by <u>the</u> address determination part 14 to <u>the</u> second

5   information-processing device 2, and then the flow returns to S101.

In the flowchart of Fig. 4, the process ends with an interruption of

power off or <u>a </u>process end.   Also, this flowchart illustrates a case

where processes such as determining an address are performed when

<u>the</u> identifier acceptor 12 accepts [[a]] <u>the</u> communication destination

10   device identifier.   However, such timing is not limited to this case, but

an address may be determined when <u>the</u> tunnel communication part 11

starts tunnel communication with <u>the</u> second information-processing

device 2, using [[a]] <u>the</u> communication destination device identifier

having been accepted by that time, for example.

15   Next, a description is made for the action of the communication

system according to this embodiment, using a concrete example.   First,

the makeup of <u>the</u> data in <u>the</u> tunnel communication is described using

Fig. 5.   Fig. 5 shows an example of communication target data before

being encapsulated (Fig. 5A) and that after being encapsulated (Fig.

20   5B).

In Fig. 5A, ~~the the ~~<u>the </u>communication target data includes <u>an </u>IP

header 101, <u>a </u>TCP/UDP header 102, and <u>a </u>payload 103.   ~~An ~~<u>The </u>

address determined by <u>the</u> address determination part 14 is used as ~~an ~~

<u>the </u>IP address used in <u>the</u> IP header 101.   <u>The </u>TCP/UDP header 102

25   may be a header for either TCP or UDP.   Payload 103 includes <u>the</u>

communication target data itself, namely information to be actually

used by <u>the</u> application software in <u>the</u> first information-processing

device 1, the second information-processing device 2, and others.

Fig. 5B shows data that is a UDP-encapsulated original packet (communication target data) shown in Fig. 5A.   In Fig. 5B, the original packet is encrypted by adding an administration header (XX

5   header 203) and a trailer (XX trailer 204) to the original packet, and is encapsulated by adding a UDP header 202 and an IP header 201.   IP addresses used in the IP header 201 are those of the first information-processing device 1 and the second information-processing device 2.

10   Next, a description is made for processes such as acquiring an address before starting communication between the first information-processing device 1 and the second information-processing device 2.   In this concrete example, the IP address of the first information-processing device 1 is to be "202.132.10.6", and then the

15   communication source device identifier is to be "12345678".   The IP address of the second information-processing device 2 is to be "131.206.10.240", and the communication destination device identifier is to be "98765432".   Still, the IP address of the server 4 is to be "155.32.10.10".

20   Tunnel communication part 11 in the first information-processing device 1 is to retain the IP address of the server 4 in advance, and it transmits the communication source device identifier "12345678" stored in the identifier storage part 13 to the IP address "155.32.10.10" of the server 4.   Then the communication source device identifier is

25   received by the server 4.   In addition, the server 4 acquires the IP address "202.132.10.6" of the first information-processing device 1[[,]] from the header of the transmitted communication source device

identifier ~~transmitted~~.   Server 4 retains the IP address "202.132.10.6"
of <u>the</u> first information-processing device 1, and ~~the the~~ <u>the</u>
communication source device identifier "12345678", making both
correspond.

5   In the same way, <u>the</u> tunnel communication part 22 in <u>the</u> second
information-processing device 2 transmits the communication
destination device identifier "98765432" stored in <u>the</u> identifier storage
part 23 to <u>the</u> server 4.   Consequently, <u>the</u> server 4 retains the IP
address "131.206.10.240" of <u>the</u> second information-processing device 2,
10   and the communication destination device identifier "98765432",
making both correspond.

        If a user is assumed to attach a detachable recording medium with
[[a]] <u>the</u> communication destination device identifier recorded therein
into a slot (not illustrated) of <u>the</u> first information-processing device 1,
15   and the communication destination device identifier "98765432"
recorded on the recording medium is accepted by <u>the</u> identifier acceptor
12 to be passed to <u>the</u> address determination part 14 and<u>the</u> tunnel
communication part 11 (S101).

        Tunnel communication part 11 transmits to <u>the</u> server 4, the
20   communication destination device identifier "98765432" received from
<u>the</u> identifier acceptor 12, and an instruction of transmitting the IP
address of the device identified by the communication destination
device identifier.   Server 4 then receives them to transmit the IP
address "131.206.10.240" being retained to <u>the</u> first
25   information-processing device 1, corresponding to the communication
destination device identifier "98765432".

        Tunnel communication part 11 in <u>the</u> first information-processing

device 1 , when accepting the IP address "131.206.10.240" of the second

information-processing device 2 from the server 4, retains the IP

address.

Address determination part 14, when receiving [[a]] the

5   communication destination device identifier from the identifier

acceptor 12, reads [[a]] the communication source device identifier

stored in the identifier storage part 13, and determines ~~an~~ the IP

address used for the communication target data in the tunnel

communication, according to the communication destination device

10   identifier and the communication source device identifier.   Specifically,

the address determination part 14 determines an address with one of

the following three methods, for example (S102).

[Method of Determining an Address Using a Function]

Address determination part 14 has the function "Func (argument 1,

15   argument 2)" for determining ~~an~~ the address, where the

communication source device identifier "12345678" is substituted for

argument 1, and the communication destination device identifier

"98765432" for argument 2.   Consequently, the two IP addresses

"192.168.0.1" and "192.168.0.2" are derived by calculation.   Then, the

20   former IP address "192.168.0.1" is determined as that for the first

information-processing device 1, and the latter "192.168.0.2" for the

second information-processing device 2.   They are passed to the

tunnel communication part 11 and the address transmitter 15.

[Method of Determining an Address Using a Table]

25   Address determination part 14 has the table shown by Fig. 6,

which shows a correspondence between a digit number where the

device identifier is different and an IP address.

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Address determination part 14 determines <u>the</u> IP addresses

corresponding to the values ("2" and "8") of the least significant digits

of the communication destination device identifier "98765432" and <u>the</u>

communication source device identifier "12345678", as <u>the</u> IP

5   addresses for <u>the</u> first information-processing device 1 and <u>the</u> second

information-processing device 2.   In this case, the IP address for <u>the</u>

first information-processing device 1 is "192.168.0.8", and <u>the address</u>

<u>for the</u> second information-processing device 2 is "192.168.0.2".   Here,

if the values of the least significant digits of the communication

10   destination device identifier and <u>the</u> communication source device

identifier are identical (both "2", for example), ~~judgement~~

<u>determination</u> is further made for the next digit (one digit to the left),

and if they are also identical, ~~judgement~~ <u>determination</u> is made for the

further next digit.   In this way, comparison is made from the least

15   significant digit in order for the communication destination device

identifier and communication source device identifier, and then <u>the</u> IP

addresses are determined at the digit with different values, using the

table of Fig. 6.   The determined IP addresses for <u>the</u> first

information-processing device 1 and <u>the</u> second information-processing

20   device 2, namely "192.168.0.8" and "192.168.0.2" are passed to <u>the</u>

tunnel communication part 11 and <u>the</u> address transmitter 15.

[Method of Determining an Address by Magnitude Comparison of

Device Identifiers]

Address determination part 14 has the IP addresses "192.168.0.1"

25   and "192.168.0.2", corresponding to those for the smaller and larger

device identifiers, respectively.   Comparison is made for the

communication destination device identifier "98765432" and <u>the</u>

communication source device identifier "12345678", and then the IP

address "192.168.0.2" is allocated to the larger one, and "192.168.0.1"

to the smaller.   Consequently, the IP address for first

information-processing device 1 is determined as "192.168.0.1", and

5   the second information-processing device 2 as "192.168.0.2".   Address

determination part 14 passes these determined addresses to the tunnel

communication part 11 and the address transmitter 15.

Here, the description is made for a case of magnitude comparison

of device identifiers.   However, an address may be determined in the

10   following way.   That is, another method of comparison is made with a

given algorithm, and then selection is made from a plurality of (usually

two) predetermined addresses.

One example is that the magnitude comparison is made for the

least significant digit (if both values of the least significant digits are

15   identical, a digit with different values, closest to the least significant

one), and then an address is selected according to the comparison

result.   Another example is, if a device identifier is composed of

alphabetical characters, to judge which device identifier is closer to "A"

in so-called lexicographic order (in other words, the identifier is listed

20   earlier in a dictionary).

In the above-mentioned concrete example, the description is made

for three different methods of determining addresses.   However, it is

sufficient if the address determination part 14 determines an address

according to two device identifiers, and thus another method of

25   determining addresses may be used.   For example, instead of using a

table, the values of the least significant digit of [[a]] the

communication source device identifier and [[a]] the communication

destination device identifier may be substituted for a given function to calculate an IP address.

Address transmitter 15 transmits the IP address (to be "192.168.0.1") of <u>the</u> first information-processing device 1 and the IP address (to be "192.168.0.2") of <u>the</u> second information-processing device 2, both determined by <u>the</u> address determination part 14, to the IP address "131.206.10.240" of <u>the</u> second information-processing device 2, retained by <u>the</u> tunnel communication part 11 (S103). Consequently, these IP addresses are accepted by <u>the</u> address acceptor 21 in <u>the</u> second information-processing device 2 and passed to <u>the</u> tunnel communication part 22. Here, the IP addresses to be transmitted are to be identified as for <u>the</u> first information-processing device 1 or <u>the</u> second information-processing device 2, by <u>the</u> second information-processing device 2. One example is that a corresponding information-processing device may be predetermined according to the order of <u>the</u> IP addresses to be transmitted. Alternatively, information or flags for identifying an information-processing device, corresponding to the IP address, are transmitted, and a corresponding information-processing device may be predetermined according to the information or flags.

Tunnel communication part 11, when receiving the IP address "192.168.0.1" of <u>the</u> first information-processing device 1 and "192.168.0.2" of <u>the</u> second information-processing device 2, from <u>the</u> address determination part 14, performs <u>the</u> tunnel communication using these addresses. In other words, in <u>the</u> IP header 101, "192.168.0.1" is used as the IP address of the communication source (namely, <u>the</u> first information-processing device 1), and "192.168.0.2"

as the communication destination (namely, the second

information-processing device 2).   Here, in the IP header 201 of the

packet (illustrated in Fig. 5B) that is the communication target data

having been encapsulated, "202.132.10.6" is used as the IP address of

5   the communication destination, and "131.206.10.240" as the

communication source.   Similarly, in the IP header 101 for the second

information-processing device 2, "192.168.0.1" is used as the IP

address of the first information-processing device 1, and "192.168.0.2"

as the second information-processing device 2.   Further, in the IP

10   header 201, "131.206.10.240" is used as the IP address of the

communication destination (namely, the second information-processing

device 2), and "202.132.10.6" as the communication source (namely, the

first information-processing device 1).   In such a way, communication

is performed between the first information-processing device 1 and the

15   second information-processing device 2.

This concrete example describes a case for UDP tunnel

communication.   However, tunnel communication is not limited to this

type, but it may be an HTTP tunnel communication and others as

mentioned above.   Also, the data structure is not limited to that in Fig.

20   5.

As mentioned above, the communication system according to this

embodiment determines addresses used for communication target data

in tunnel communication, according to [[a]] the communication

destination device identifier and the communication source device

25   identifier.   Therefore, addresses can be determined with a

deterministic algorithm, which is simpler than a heuristic algorithm.

As a result, inquiries to a server and others are not required, enabling

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addresses to be determined in a short time.   Meanwhile, an address to

be used for communication target data encapsulated in <u>the</u> tunnel

communication is different from that used in communication via <u>the</u>

communication line 3, and thus for a different tunnel communication

5   (namely, tunnel communication with a different set of

information-processing devices for<u> the</u> communication source and

destination), the same address can be used.   This has an advantage of

<u>an </u>unlimited number of allocation addresses, unlike in cases with

DHCP or AutoIP.

10   In this embodiment, the description is made for a makeup where

<u>the</u> first information-processing device 1 is equipped with <u>the</u> address

transmitter 15.   However, <u>the</u> first information-processing device 1

may have an address output part for outputting an address determined

by <u>the</u> address determination part 14, instead of <u>the</u> address

15   transmitter 15.   Here, this output may be, for example, <u>a</u> display on a

display device (e.g. CRT or liquid crystal display), <u>a </u>transmission to a

given device via communication lines, <u>a</u> printing by a printer, <u>a</u>

recording on a given recording medium, or <u>a</u> sound output by a speaker.

The address output part may optionally include an output device (e.g.

20   display device or printer).   Also, the address output part may be

implemented with hardware, or software such as a driver for driving

such [[a]] <u>the</u> device.   The address having been output may be set in

<u>the</u> second information-processing device 2, for example, by being

recorded on a given recording medium, or by being sent to the user of

25   second information-processing device 2 via email, facsimile, or the like

(Embodiment 2)

A description is made for a communication system according to

embodiment 2 of the present invention, referring to drawings.   The
communication system according to this embodiment determines an
address used for communication target data in tunnel communication
at the respective information-processing devices.

5   The communication system according to this embodiment is to be
the same as that in Fig. 1, where the first information-processing
device 1 is to correspond to a ~~first information-processing device 1a~~first
information-processing device 1a, and the second
information-processing device 2 to a second information-processing

10   device 2a.   Fig. 7 is a block diagram showing the makeup of ~~first~~
~~information-processing device 1a~~the first information-processing
device 1a according this embodiment.   First information-processing
device 1a according to this embodiment is equipped with ~~tunnel~~
~~communication part 11~~an tunnel communication part 11, an identifier

15   acceptor 12, the identifier storage part 13, and ~~address determination~~
~~part 14~~an address determination part 14.   Here, ~~tunnel~~
~~communication part 11~~the tunnel communication part 11, ~~identifier~~
~~acceptor 12~~the identifier acceptor 12, the identifier storage part 13,
and ~~address determination part 14~~the address determination part 14

20   are the same as those in embodiment 1, and thus their descriptions are
omitted.
          Fig. 8 is a block diagram showing the makeup of ~~second~~
~~information-processing device 2a~~the second information-processing
device 2a according to this embodiment.   Second

25   information-processing device 2a according to this embodiment is
equipped with an identifier storage part 23, an tunnel communication
part 24, an identifier acceptor 25, and an address determination part

26.   Here, ~~identifier storage part 23~~the identifier storage part 23 is

the same as that in embodiment 1, and thus its description is omitted.

Also, ~~tunnel communication part 24~~the tunnel communication part 24,

~~identifier acceptor 25~~the identifier acceptor 25, and the address

5   determination part 26 are the same as ~~tunnel communication part 11~~the tunnel communication part 11, ~~identifier acceptor 12~~the

identifier acceptor 12, and ~~address determination part 14~~the address

determination part 14 in embodiment 1, respectively, and thus their

descriptions are omitted.

10   In addition, the action for determining an address by ~~first information-processing device 1a~~the first information-processing

device 1a in this embodiment is the same as that in Fig. 4 in

embodiment 1, except that it does not perform ~~a~~the process to transmit

~~an~~the address at S103, and thus its description is omitted.   Also, the

15   action for determining an address by ~~second information-processing device 2a~~the second information-processing device 2a in this

embodiment is the same as that in Fig. 4 in embodiment 1, except that

it ~~judges~~ determines whether a communication source device identifier,

instead of a communication destination device identifier, is accepted at

20   S101, and it does not perform ~~a~~the process to transmit ~~an~~the address

at S103, and thus its description is omitted.

Next, a description is made for the action of the communication

system according to this embodiment, using ~~an~~a concrete example.   In

this concrete example, the data structure in the tunnel communication

25   is to be the same as that shown in Fig. 5.   Also, IP addresses, device

identifiers, and others, of ~~first information-processing device 1a~~the

first information-processing device 1a and others in this concrete

example are to be the same as those ~~described~~ <u>described</u> in embodiment 1.

First, a description is made for processes such as acquiring an address before ~~first information-processing device 1a~~<u>the first information-processing device 1a</u> and ~~second information-processing device 2a~~<u>the second information-processing device 2a</u> start communication.   The following actions are the same as those of the concrete example in embodiment 1, and thus their descriptions are omitted.   That is, ~~first information-processing device 1a~~<u>the first information-processing device 1a</u> and ~~second information-processing device 2a~~<u>the second information-processing device 2a</u> transmit their respective device identifiers to ~~server 4~~<u>the server 4</u>.   Consequently, ~~server 4~~<u>the server 4</u> retains the IP address "202.132.10.6" of ~~first information-processing device 1a~~<u>the first information-processing device 1a</u>, and<u> the</u> communication source device identifier "12345678", making both correspond; and the IP address "131.206.10.240" of ~~second information-processing device 2a~~<u>the second information-processing device 2a</u>, and the communication destination device identifier "98765432", making both correspond.

Next, the actions after a detachable recording medium with a communication device identifier recorded therein is attached into a slot (not illustrated) of ~~first information-processing device 1a~~<u>the first information-processing device 1a</u>, and before ~~an~~ <u>the</u> IP address used for communication target data in tunnel communication is determined by ~~first information-processing device 1a~~<u>the first information-processing device 1a</u>, are also the same as those of the concrete example in embodiment 1, and thus their descriptions are omitted.

Here, ~~server 4~~<u>the server 4</u> is assumed to transmit ~~an~~ <u>the</u> IP

address of ~~second information-processing device 2a~~the second information-processing device 2a to ~~first information-processing device 1a~~the first information-processing device 1a, and also transmits a communication source device identifier of ~~first information-processing device 1a~~the first information-processing device 1a to ~~second information-processing device 2a~~the second information-processing device 2a. Consequently, the communication source device identifier "12345678" is accepted by ~~identifier acceptor 25~~the identifier acceptor 25 through ~~tunnel communication part 24~~the tunnel communication part 24 of ~~second information-processing device 2a~~the second information-processing device 2a. Then, ~~identifier acceptor 25~~the identifier acceptor 25 ~~judges~~determines that communication source device identifier has been accepted (S101) to perform an address determination process (S102). This process is performed in the same way as in the concrete example in embodiment 1, where a similar address is determined ~~as determined~~by ~~address determination part 14~~the address determination part 14 in ~~first information-processing device 1a~~the first information-processing device 1a. One example is that the address of ~~first information-processing device 1a~~the first information-processing device 1a is determined as "192.168.0.1", and ~~second information-processing device 2a~~the second information-processing device 2a as "192.168.0.2".

However, when using a function to determine an address, ~~address determination part 26~~the address determination part 26, in "Func(argument 1, argument 2)", substitutes the communication destination device identifier "98765432", which is ~~a~~the device identifier of ~~second information-processing device 2a~~the second

information-processing device 2a, for argument 1; and communication

source device identifier "12345678", which is the~~a~~ device identifier of

~~first information-processing device 1a~~the first information-processing

device 1a, for argument 2.   This function is assumed to reverse the

5   order of the IP addresses if argument 1 and argument 2 are swapped.

Consequently, two IP addresses "192.168.0.2" and "192.168.0.1" are

derived, and the former IP address is determined as one for ~~second-~~

~~information-processing device 2a~~the second information-processing

device 2a; the latter for ~~first information-processing device 1a~~the first

10   information-processing device 1a, resulting in determining in the same

way as in ~~address determination part 14~~the address determination

part 14.

The action of tunnel communication after this address

determination is the same as that in the concrete example of

15   embodiment 1, except that addresses are not transmitted, and thus its

description is omitted.

As mentioned above, in the communication system according to

this embodiment, ~~an~~ the address used for communication target data in

tunnel communication can be also determined by each

20   information-processing device, according to ~~a~~ the communication

destination device identifier and ~~a~~ the communication source device

identifier.   Determining ~~an~~ the address by each

information-processing device dispenses with transmitting the

address.

25   In addition, a deterministic algorithm, where a communication

destination device identifier and communication source device

identifier are used, even if each information-processing device

determines addresses, they can be determined without contradiction. Specifically, such situation can be avoided that the addresses of ~~first information-processing device 1a~~the first information-processing device 1a and ~~second information-processing device 2a~~the second

5   information-processing device 2a, both determined by ~~first information-processing device 1a~~the first information-processing device 1a; and those of ~~first information-processing device 1a~~the first information-processing device 1a and ~~second information-processing device 2a~~the second information-processing device 2a, both determined

10   by ~~second information-processing device 2a~~the second information-processing device 2a, lose their integrity.

In this embodiment, the description is made for a case where the addresses of ~~a~~the communication source and destination are determined by each information-processing device.   However, when

15   only the address of the first information-processing device is determined by ~~first information-processing device 1a~~the first information-processing device 1a, and when only the address of the second information-processing device is determined by ~~second information-processing device 2a~~the second information-processing

20   device 2a, for example, they may be passed to the other party's information-processing device directly or indirectly.
(Embodiment 3)

A description is made for a communication system according to embodiment 3 of the present invention, referring to drawings.   In the

25   communication system according to this embodiment, an address used for communication target data in tunnel communication is determined by a server.

Fig. 9 shows the makeup of the communication system according to this embodiment.   In Fig. 9, the communication system according to this embodiment is equipped with a first information-processing device 5, a second information-processing device 6, and a ~~server 7~~the server 7, all connected one another via a ~~communication line 3~~the communication line 3.

First ~~information-processing device 5~~the information-processing device 5 is equipped with an address acceptor 51 and a ~~tunnel communication part 52~~the tunnel communication part 52.

Address acceptor 51 accepts an address used for communication target data in tunnel communication performed between first ~~information-processing device 5~~the information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6.   Address acceptor 51 may, for example, accept an address having been input from an input device (e.g. keyboard, mouse, or touch panel), may accept an address transmitted through wired or wireless communication lines, or may accept an address read from a given recording medium (e.g. optical disc, magnetic disk, or semiconductor memory).   In this embodiment, an address transmitted from ~~server 7~~the server 7 through ~~communication line 3~~the communication line 3 is to be accepted.

Tunnel communication part 52 performs tunnel communication between first ~~information-processing device 5~~the information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6.   Tunnel communication part 52 is assumed to retain a first device identifier for identifying first ~~information-processing device 5~~the

information-processing device 5, and a second device identifier for identifying ~~second information-processing device 6~~the second information-processing device 6.   The second device identifier may be, for example, ~~what having been~~ from an input ~~from~~ of an input device,

5   transmitted through a given communication line, or read from a given recording medium.   Here, the makeup of ~~tunnel communication part 52~~the tunnel communication part 52 is the same as that of ~~tunnel communication part 11~~the tunnel communication part 11 in embodiment 1, except that the first device identifier corresponds to a

10   communication source device identifier, and the second device identifier to the communication destination device identifier, and thus its description is omitted.

Second information-processing device 6 is equipped with an address acceptor 61 and a tunnel communication part 62.   The address

15   acceptor 61 and tunnel communication part 62 are the same as ~~address acceptor 51~~the address acceptor 51 and ~~tunnel communication part 52~~the tunnel communication part 52, respectively, and thus their descriptions are omitted.   Here, the tunnel communication part 62 does not need to retain the first device identifier.

20   Server 7 performs a process to establish tunnel communication performed between first ~~information-processing device 5~~the information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, in the same way as ~~server 4~~the server 4 in embodiment 1, and also determines an address

25   used in the tunnel communication, equipped with a communication control unit 71, an identifier acceptor 72, an address determination part 73, and an address transmitter 74.

Communication control unit 71 performs processes such as establishing tunnel communication between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6.   More specifically, it transmits an address of ~~second information-processing device 6~~the second information-processing device 6 to first ~~information-processing device 5~~the information-processing device 5, for example.

Identifier acceptor 72 accepts first device identifier and second device identifier.   Identifier acceptor 72, for example, may accept ~~a~~the first device identifier and others having been input from an input device (e.g. keyboard, mouse, or touch panel), ~~a~~the first device identifier and others transmitted through wired or wireless communication lines, or ~~a~~the first device identifier and others read from a given recording medium (e.g. optical disc, magnetic disk, or semiconductor memory).   In this embodiment, ~~a~~the first device identifier and others passed from the communication control unit 71 is to be accepted.

Address determination part 73 determines a first address of ~~first information-processing device 5~~the first information-processing device 5 and a second address of ~~second information-processing device 6~~the second information-processing device 6, according to a first device identifier and second device identifier accepted by the identifier acceptor 72.   These addresses are used for communication target data in tunnel communication.   The method of determining an address is the same as that by ~~address determination part 14~~the address determination part 14 in embodiment 1, and thus its description is

omitted.

Address transmitter 74 transmits a first address and second address determined by the address determination part 73, to ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6.   This transmission may be directly performed to ~~first information-processing device 5~~the first information-processing device 5, or indirectly via a given server or the like.

Next, a description is made for the action of a communication system, in particular, the action for determining an address, according to this embodiment.   Fig. 10 is a flowchart showing the action to determine an address by ~~server 7~~the server 7.

(S201) Identifier acceptor 72 ~~judges~~ determines whether the first device identifier and the second device identifier have been accepted. If accepted, the identifiers are passed to the address determination part 73, and then the flow goes to S202; otherwise, process S201 is repeated until they are accepted.

(S202) Address determination part 73 determines an address used for communication target data in tunnel communication, according to the first device identifier and the second device identifier received from the identifier acceptor 72.   Then, the determined address is passed to the address transmitter 74.

(S203) Address transmitter 74 transmits two addressees determined by the address determination part 73, to ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second

information-processing device 6, and then the flow returns to S101.
In the flowchart of Fig. 10, the process ends with an interruption of
power off or process end.   Also, this flowchart illustrates a case where
processes such as determining an address are performed when the

5   identifier acceptor 72 accepts a first device identifier and others.
However, such a timing is not limited to this case, but an address may
be determined when ~~first information-processing device 5~~the first
information-processing device 5 and ~~second information-processing
device 6~~the second information-processing device 6 start tunnel

10   communication, using a first device identifier and others having been
accepted by that time, for example.

In addition, in the flowchart of Fig. 10, the description is made for
a case where the~~a~~ first device identifier and the second device
identifier are accepted simultaneously at S201.   However, these device

15   identifiers may be accepted simultaneously, or at different timings.
However, it is after both device identifiers are accepted that ~~an~~ the
address is determined, which is the same as in the flowchart of Fig. 10.

Next, a description is made for the action of the communication
system according to this embodiment, using a concrete example.   In

20   this concrete example, the data structure in tunnel communication is
assumed to be the same as in Fig. 5.   Further, the IP address of ~~first
information-processing device 5~~the first information-processing device
5 is assumed to be "202.132.10.6", and the first device identifier,
"12345678".   Also, the IP address of ~~second information-processing

25   device 6~~the second information-processing device 6 is assumed to be
"131.206.10.240", and the second device identifier, "98765432".   Still,
the IP address of ~~server 7~~the server 7 is assumed to be "155.32.10.10".

Tunnel communication part 52 in ~~first information-processing device 5~~ the first information-processing device 5 is assumed to retain an IP address of ~~server 7~~ the server 7 in advance.   Then, ~~tunnel communication part 52~~ the tunnel communication part 52 transmits the

5   retained first device identifier "12345678" to the IP address "155.32.10.10" of ~~server 7~~ the server 7.   Consequently, the first device identifier is received by communication control unit 71 of ~~server 7~~ the server 7.   Then, the IP address "202.132.10.6" of first ~~information-processing device 5~~ the first information-processing device

10   5 is acquired from the header of the first device identifier. Communication control unit 71 retains the IP address of the ~~first information-processing device 5~~ the first information-processing device 5, making it correspond with the first device identifier.

In the same way, tunnel communication part 62 in ~~second information-processing device 6~~ the second information-processing

15   device 6 also transmits the second device identifier "98765432" to ~~server 7~~ the server 7.   Consequently, in communication control unit 71, address identifier correspondence information, which is information with a device identifier and IP address, both corresponding, is to be

20   retained, as shown in Fig. 11.

Next, ~~tunnel communication part 52~~ the tunnel communication part 52 of ~~first information-processing device 5~~ the first information-processing device 5 transmits to ~~server 7~~ the server 7, a second device identifier for identifying ~~second information-processing device 6~~

25   ~~device 6~~ the second information-processing device 6, and a request to perform tunnel communication with ~~second information-processing device 6~~ the second information-processing device 6.   Consequently,

the information is received by communication control unit 71.

Communication control unit 71 acquires an IP address of ~~first information-processing device 5~~the first information-processing device 5 from the header of a packet transmitted from ~~first~~

5   ~~information-processing device 5~~the first information-processing device 5, refers to address identifier correspondence information shown in Fig. 11, and acquires the first device identifier "12345678" of ~~first information-processing device 5~~the first information-processing device 5. Communication control unit 71 acquires the IP address

10   "131.206.10.240" corresponding to the second device identifier "98765432" transmitted from ~~first information-processing device 5~~the first information-processing device 5, referring to the address identifier correspondence information.   Then, communication control unit 71 passes first device identifier "12345678" and second device

15   identifier "98765432" to identifier acceptor 72, and also transmits the IP address "131.206.10.240" of ~~second information-processing device 6~~the second information-processing device 6 to ~~first information-processing device 5~~the first information-processing device 5.

20   Identifier acceptor 72, when accepting the first device identifier "12345678" and second device identifier "98765432" from communication control unit 71 (S201), passes them to address determination part 73.   Address determination part 73 receives these device identifiers, determines addresses according to the device

25   identifiers, and passes the determined addresses, making them correspond to the device identifiers, to address transmitter 74 (S202). This method of determining an address is the same as that of the

concrete example in embodiment 1, and thus its description is omitted.

Address transmitter 74, when receiving from address determination part 73 a set of the device identifier "12345678" and its corresponding IP address "192.168.0.1", and a set of the device

5   identifier "98765432" and its corresponding IP address "192.168.0.2", acquires the IP addresses of the information-processing devices corresponding to the respective IP addresses, referring to address identifier correspondence information retained in communication control unit 71.   Then, address transmitter 74 transmits the two sets

10 of the device identifiers and IP addresses to the IP address "202.132.10.6" of ~~first information-processing device 5~~the first information-processing device 5 and "131.206.10.240" of ~~second information-processing device 6~~the second information-processing device 6.

15 Address acceptor 51, when accepting these sets, passes them to ~~tunnel communication part 52~~the tunnel communication part 52. Tunnel communication part 52 receives the IP address of ~~second information-processing device 6~~the second information-processing device 6 transmitted from communication control unit 71, and further

20 receives a set of the IP address and device identifier accepted by ~~address acceptor 51~~the address acceptor 51.   Then, ~~tunnel communication part 52~~the tunnel communication part 52 uses the IP address "192.168.0.1" corresponding to the first device identifier "12345678" of first ~~information-processing device 5~~the first

25 information-processing device 5, as an IP address of the communication source (namely, ~~first information-processing device 5~~the first information-processing device 5) in IP header 101, and also

uses the IP address "192.168.0.2" corresponding to the second device
identifier "98765432" of ~~second information-processing device 6~~the
second information-processing device 6, as an IP address of the
communication destination (namely, ~~second information-processing
device 6~~the second information-processing device 6) in IP header 101.

5 Then, ~~tunnel communication part 52~~the tunnel communication part 52
encapsulates the data, composes a UDP packet as shown in Fig. 5B,
and transmits the packet to ~~second information-processing device 6~~the
second information-processing device 6 to start tunnel communication.

10 Address acceptor 61 in ~~second information-processing device 6~~the
second information-processing device 6 also accepts a set of an IP
address and device identifier to pass them to tunnel communication
part 62.   Tunnel communication part 62 uses an IP address
corresponding to the second device identifier of ~~second
information-processing device 6~~the second information-processing

15 device 6, as an IP address of ~~second information-processing device 6~~the
second information-processing device 6 for communication target data
in tunnel communication.   In this way, tunnel communication is
performed between ~~first information-processing device 5~~the first
information-processing device 5 and ~~second information-processing

20 device 6~~the second information-processing device 6.

As mentioned above, in the communication system according to
this embodiment, ~~server 7~~the server 7 can determine an address used
for communication target data in tunnel communication performed

25 between ~~first information-processing device 5~~the first
information-processing device 5 and ~~second information-processing
device 6~~the second information-processing device 6, according to a

communication destination device identifier and a communication source device identifier.   This enables an address to be easily determined with a simple deterministic algorithm.

In this embodiment, the description is made for a case where address transmitter 74 transmits an address determined by address determination part 73.   However, an address output part for outputting an address determined by address determination part 73 may be equipped instead of address transmitter 74.   Here, this output may be, for example, display on a display device (e.g. CRT or liquid crystal display), transmission to a given device via communication lines, printing by a printer, recording on a given recording medium, or sound output by a speaker.   The address output part may optionally include an output device (e.g. display device or printer).   Also, the address output part may be implemented with hardware, or software such as a driver for driving such a device.   The address having been output may be set in ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, for example, by being recorded on a given recording medium, or by being sent to the user of first information-processing device 1 or second information-processing device 2 by the administrator of ~~server 7~~the server 7 via email, facsimile, or the like

Further, in this embodiment, the description is made for a case where address transmitter 74 of ~~server 7~~the server 7 transmits two addressees determined by address determination part 73 to ~~second information-processing device 6~~the second information-processing device 6.   However, address transmitter 74 may transmit only the

address "192.168.0.2" of ~~second information-processing device 6~~the second information-processing device 6 to ~~second information-processing device 6~~the second information-processing device 6.   In this case, ~~second information-processing device 6~~the

5   second information-processing device 6 can acquire an address of ~~first information-processing device 5~~the first information-processing device 5 from the header of encapsulated communication target data transmitted from ~~first information-processing device 5~~the first information-processing device 5

10   In addition, in this embodiment, the description is made for a case where ~~server 7~~the server 7 transmits addresses of both ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6.   However, ~~server 7~~the server 7 may

15   transmit the address "192.168.0.1" of ~~first information-processing device 5~~the first information-processing device 5 to ~~information-processing device 5~~the first information-processing device 5 first; the address "192.168.0.2" of ~~second information-processing device 6~~the second information-processing device 6, to ~~second

20   information-processing device 6~~the second information-processing device 6, and then ~~server 7~~the server 7 may transmit an address of the other party when an inquiry related to the address of the other party in tunnel communication is made from the information-processing device.

(Embodiment 4)

25   A description is made for a communication system according to embodiment 4 of the present invention, referring to drawings.   The communication system according to this embodiment determines an

address used for communication target data in tunnel communication, according to a determination that the information-processing device is a caller or callee.

The communication system according to this embodiment is assumed to be the same as that in Fig. 1. However, ~~first information-processing device 1~~the first information-processing device 1 corresponds to ~~first information-processing device 1~~a first information-processing device 1b, and the second information-processing device 2 to a second information-processing device 2b.

Fig. 12 is a block diagram showing the makeup of ~~first information-processing device 1~~the first information-processing device 1b according to this embodiment. ~~First information-processing device 1~~The first information-processing device 1b according to this embodiment is equipped with ~~tunnel communication part 11~~the tunnel communication part 11, ~~address determination part 14~~the address determination part 14b, address transmitter 15, and ~~judgement~~judgment part 16. Here, ~~tunnel communication part 11~~the tunnel communication part 11 and address transmitter 15 are the same as those in embodiment 1, and thus their descriptions are omitted. In addition, in ~~first information-processing device 1~~the first information-processing device 1b according to this embodiment, although an identifier storage part is not illustrated clearly, the device identifier of ~~first information-processing device 1~~the first information-processing device 1b is assumed to be stored in an accessible recording medium in ~~tunnel communication part 11~~the tunnel communication part 11.

Address determination part 14b determines an address used for communication target data encapsulated in tunnel communication, according to a determination by ~~judgement~~ the judgment part 16. It is sufficient if the address used in a device for communication destination

5   (e.g. ~~second information-processing device 2~~**the second information-processing device 2**b) and that for communication source (e.g. ~~first information-processing device 1~~the first information-processing device 1b) are different each other. Methods of determining an address include one with a given function used, and

10   one by selecting from a plurality of predetermined addresses. A concrete example of a method of determining an address is described hereinafter. In determining addresses, an address for a device for communication source and/or one for communication destination may be determined. In this embodiment, a description is made for a case

15   where both addresses for a communication source and communication destination are determined.

~~judgement~~ ~~judgment~~ Judgment part 16 ~~judges~~ determines whether ~~first information-processing device 1~~the first information-processing device 1b is a caller or callee in tunnel communication. It is sufficient

20   if ~~first information-processing device 1~~the first information-processing device 1b is judged as a caller or callee. In other words, ~~first information-processing device 1~~the first information-processing device 1b may be judged as a caller or callee by judging ~~second information-processing device 2~~**the second information-processing**

25   **device 2**b, which is the device at the other end, is a caller or callee. Alternatively, ~~judgement~~ determination is made for both ~~first information-processing device 1~~the first information-processing device

1b and ~~second information-processing device 2~~the second information-processing device 2b.   Here, a caller and callee may be those in communication for a protocol of tunnel (namely, a protocol encompassing communication target data) in tunnel communication, or

5   those for communication target data (namely, target data for encapsulation).   In this embodiment, the former case is described.   In addition, a caller is a device that starts communication, and a callee is a device that performs communication according to a call-out from an information-processing device as a caller.

10   Fig. 13 is a block diagram showing the makeup of ~~second information-processing device 2~~the second information-processing device 2b according to this embodiment.   Second information-processing device 2b according to this embodiment is equipped with an address acceptor 21 and a tunnel communication part

15   22.   Here, ~~address acceptor 21~~the address acceptor 21 and a ~~tunnel communication part 22~~the tunnel communication part 22 are the same as those in embodiment 1, and thus their descriptions are omitted.   In addition, in ~~second information-processing device 2~~the second information-processing device 2b according to this embodiment,

20   although an identifier storage part is not illustrated clearly, the device identifier of ~~second information-processing device 2~~the second information-processing device 2b is assumed to be stored in an accessible recording medium in ~~tunnel communication part 22~~the tunnel communication part 22.

25   Next, a description is made for the action of a communication system, in particular, the action for determining an address in ~~first information-processing device 1~~the first information-processing device

1b, according to this embodiment.   Fig. 14 is a flowchart showing the action to determine an address in ~~first information-processing device 1~~the first information-processing device 1b.

(S301) Tunnel communication part 11 ~~judges~~ determines whether

5   or not to start tunnel communication.   Starting this tunnel communication includes two cases: a case where ~~first information-processing device 1~~the first information-processing device 1b actively starts tunnel communication, and a case where tunnel communication starts according to a request from another device

10   (~~second information-processing device 2~~the second information-processing device 2b, here).   In either case, ~~tunnel communication part 11~~the tunnel communication part 11 ~~judges~~ determines that tunnel communication is to be started.   If started, the flow goes to S302; otherwise, repeats process S301 until tunnel

15   communication is started.

(S302) ~~judgement~~ Judgment part 16 ~~judges~~ determines whether ~~first information-processing device 1~~the first information-processing device 1b is a caller or callee.

(S303) Address determination part 14b determines an address

20   used for communication target data in tunnel communication according to a determination by ~~judgement~~ the judgment part 16, namely whether ~~first information-processing device 1~~the first information-processing device 1b is a caller or callee.

(S304) Address transmitter 15 transmits an address determined by

25   ~~address determination part 14~~the address determination part 14b to ~~second information-processing device 2~~the second information-processing device 2b.   Then the flow returns to S301.

Here, in the flowchart of Fig. 14, the process ends with an interruption of power off or process end. Still, this flowchart illustrates only a process for determining an address; however, it is obvious that this determined address is used for tunnel communication.

5   Next, a description is made for the action of the communication system according to this embodiment, using a concrete example. First, the data structure in the tunnel communication is the same as that in Fig. 5 in embodiment 1. In addition, the IP addresses and device identifiers of information-processing devices and a server are assumed

10   to be the same as those in the concrete example in embodiment 1. Further, the processes in which ~~first information-processing device 1~~the first information-processing device 1b and ~~second information-processing device 2~~the second information-processing device 2b respectively register IP addresses and device identifying

15   information to ~~server 4~~the server 4 are the same as those in embodiment 1, and thus their descriptions are omitted.

It is assumed that a detachable recording medium with a communication destination device identifier recorded therein is attached to ~~first information-processing device 1~~the first

20   information-processing device 1b, and the communication destination device identifier "98765432" stored in the recording medium is accepted by an acceptor (not illustrated) and is passed to ~~tunnel communication part 11~~the tunnel communication part 11.

Then, ~~tunnel communication part 11~~the tunnel communication

25   part 11 ~~judges~~ determines that tunnel communication is to be started (S301), and transmits to ~~server 4~~the server 4 the received communication destination device identifier and an instruction of

transmitting an IP address of a device identified by the communication

destination device identifier.   Consequently, ~~server 4~~the server 4

receives them, and then transmits the retained IP address

"131.206.10.240", corresponding to the communication destination

5   device identifier "98765432", to ~~first information-processing device~~

~~1~~the first information-processing device 1b.   Tunnel communication

part 11 of ~~first information-processing device 1~~the first

information-processing device 1b, when accepting the IP address

"131.206.10.240" of ~~second information-processing device 2~~**the second**

10   **information-processing device 2**b from ~~server 4~~the server 4, retains the

IP address.

~~Judgement~~ Judgment part 16 ~~judges~~ determines that ~~first~~

~~information-processing device 1~~the first information-processing device

1b is a caller because ~~tunnel communication part 11~~the tunnel

15   communication part 11 is a caller in communication for a protocol of

tunnel in tunnel communication (S302), and then passes the

determination to ~~address determination part 14~~the address

determination part 14b.

Address determination part 14b, when receiving a determination

20   from ~~judgement~~ judgment part 16, determines an IP address used for

communication target data in tunnel communication according to the

determination.   Specifically, ~~address determination part 14~~the

address determination part 14b determines an address according to,

for example, any one of the following three methods (S303).

25   [Method of Determining an Address by a Caller and Callee]

Address determination part 14b has the table shown in Fig. 15A.

The table of Fig. 15A shows correspondence between information

showing a caller or callee, and IP addresses.   Address determination

part 14b determines an IP address of ~~first information-processing~~ ~~device 1~~the first information-processing device 1b as

"192.168.0.1"using the table of Fig. 15A, because ~~judgement~~ judgment

5   part 16 has judged that ~~first information-processing device 1~~the first information-processing device 1b is a caller.   Meanwhile, ~~address determination part 14~~the address determination part 14b determines

an IP address of ~~second information-processing device 2~~the second information-processing device 2b as "192.168.0.2", because ~~second~~

10   ~~information-processing device 2~~the second information-processing device 2b is a callee.   Here, Fig. 15A shows correspondence of

information showing a caller or callee with IP addresses in a tabular

form.   However, they may be made correspond with a means other

than a tabular form.

15   [Method of Determining an Address by Selecting from a Plurality of Addresses]

Address determination part 14b has a table shown in Fig. 15B.

The table of Fig. 15B shows correspondence between information

showing a caller or callee, and IP addresses, where four IP addresses

20   correspond to a piece of information showing a caller or callee.

Therefore, ~~address determination part 14~~the address determination part 14b is to select one IP address from the four IP addresses.   This

selection may be made, for example, in a random order, or in a

sequential order.   In this concrete example, ~~address determination~~

25   ~~part 14~~the address determination part 14b determines an IP address of

~~first information-processing device 1~~the first information-processing device 1b as "192.168.0.1"using the table of Fig. 15B, because

~~judgement~~ <u>judgment</u> part 16 has judged that ~~first information-processing device 1~~<u>the first information-processing device 1</u>b is a caller.   Meanwhile, ~~address determination part 14~~<u>the address determination part 14</u>b determines an IP address of ~~second information-processing device 2~~<u>the second information-processing device 2</u>b as "192.168.0.2", because ~~second information-processing device 2~~<u>the second information-processing device 2</u>b is a callee.

[Method of Determining an Address Using a Function]

Address determination part 14b has the function "Func(argument 1)" for determining an address.   When calculating an address of caller, "0" is substituted for argument 1.   Consequently, the IP address "192.168.0.1" is derived.   This IP address "192.168.0.1" becomes an IP address of ~~first information-processing device 1~~<u>the first information-processing device 1</u>b at the caller side.   Meanwhile, when calculating an address of a callee, "1" is substituted for argument 1. Consequently, the IP address "192.168.0.2" is derived.   This IP address "192.168.0.2" becomes an IP address of ~~second information-processing device 2~~<u>the second information-processing device 2</u>b at the callee side.

Here, the description is made for three different methods of determining an address.   However, it is sufficient if ~~address determination part 14~~<u>the address determination part 14</u>b determines an address according to a determination that the information-processing device is caller or callee, and thus an address may be determined with a method other than these methods.

Address transmitter 15, in the same way as in the concrete example in embodiment 1, transmits the determined IP addresses

"192.168.0.1" of ~~first information-processing device 1~~the first information-processing device 1b and "192.168.0.2" of ~~second information-processing device 2~~the second information-processing device 2b, to ~~second information-processing device 2~~the second

5   information-processing device 2b (S304).   Consequently, these IP addresses are accepted by ~~address acceptor 21~~the address acceptor 21 in ~~second information-processing device 2~~the second information-processing device 2b and passed to ~~tunnel communication part 22~~the tunnel communication part 22.   Meanwhile, ~~tunnel~~

10   ~~communication part 11~~the tunnel communication part 11, in the same way as in the concrete example in embodiment 1, uses the determined address to perform tunnel communication, and ~~tunnel communication part 22~~the tunnel communication part 22 uses an address accepted by ~~address acceptor 21~~the address acceptor 21 to perform tunnel

15   communication.

     As mentioned above, the communication system according to this embodiment can determine an address used for communication target data in tunnel communication, according to whether the information-processing device is a caller or callee, which is a

20   deterministic algorithm, simpler than a heuristic one.   Consequently, this embodiment has the same advantage as embodiment 1.

     In this embodiment, the description is made for a structure where ~~first information-processing device 1~~the first information-processing device 1b has address transmitter 15.   However, ~~first~~

25   ~~information-processing device 1~~the first information-processing device 1b may have an address output part for outputting an address determined by ~~address determination part 14~~the address

determination part 14b, instead of address transmitter 15.   Here, this

output may be, for example, display on a display device (e.g. CRT or

liquid crystal display), transmission to a given device via

communication lines, printing by a printer, recording on a given

5   recording medium, or sound output by a speaker.   The address output

part may optionally include an output device (e.g. display device or

printer).   Also, the address output part may be implemented with

hardware, or software such as a driver for driving such a device.   The

address having been output may be set in ~~second~~

10   ~~information-processing device 2~~the second information-processing

device 2b, for example, by being recorded on a given recording medium,

or by being sent to the user of ~~second information-processing device~~

~~2~~the second information-processing device 2b via email, facsimile, or

the like

15   (Embodiment 5)

A description is made for a communication system according to

embodiment 5 of the present invention, referring to drawings.   In the

communication system according to this embodiment, each

information-processing device determines an address used for

20   communication target data in tunnel communication, according to a

determination whether an information-processing device is a caller or

callee.

Fig. 16 shows the makeup of the communication system according

to this embodiment.   The communication system is the same as that in

25   Fig. 1 in embodiment 1, except that it has ~~first information-processing~~

~~device 1~~a first information-processing device 1c instead of ~~first~~

~~information-processing device 1~~the first information-processing device

1, and ~~second information-processing device 2~~a second information-processing device 2c instead of ~~second information-processing device 2~~the second information-processing device 2 in Fig. 16, and thus their descriptions are omitted.

5   In Fig. 16, ~~first information-processing device 1~~the first information-processing device 1c according to this embodiment is equipped with ~~tunnel communication part 11~~the tunnel communication part 11, ~~address determination part 14~~the address determination part 14b, and ~~judgement~~ the judgment part 16.   Here, ~~tunnel communication part 11~~the tunnel communication part 11, ~~address determination part 14~~the address determination part 14b, and ~~judgement~~ the judgment part 16 are the same as those in embodiment 4, and thus their descriptions are omitted.

       In Fig. 16, ~~second information-processing device 2~~the second information-processing device 2c according to this embodiment is equipped with ~~tunnel communication part 22~~a tunnel communication part 22, ~~address determination part 26~~an address determination part 26c, and ~~judgement~~ a judgment part 27.   Here, ~~tunnel communication part 22~~the tunnel communication part 22 is the same as that in embodiment 4.   Further, ~~address determination part 26~~the address determination part 26c and ~~judgement~~ judgment part 27 are the same as ~~address determination part 14~~the address determination part 14b and ~~judgement~~ the judgment part 16, respectively, in embodiment 4, and thus their descriptions are omitted.

25   In addition, the action to determine an address in ~~first information-processing device 1~~the first information-processing device 1c is the same as shown in Fig. 14 in embodiment 4 except for the

process of transmitting an address at S304, and thus its description is

omitted.   Also, the action to determine an address in ~~second information-processing device 2~~the second information-processing

device 2c in this embodiment is the same as shown in Fig. 14 in

5   embodiment 4, except that ~~tunnel communication part 11~~the tunnel

communication part 11, ~~address determination part 14~~the address

determination part 14b, and ~~judgement~~ judgment part 16 correspond to

~~tunnel communication part 22~~the tunnel communication part 22,

~~address determination part 26~~the address determination part 26c, and

10   ~~judgement~~ the judgment part 27, respectively, an that they do not

perform a process of transmitting an address at S304, and thus their

descriptions are omitted.

Next, a description is made for the action of the communication

system according to this embodiment, using a concrete example.   Here,

15   it is assumed that ~~first information-processing device 1~~the first

information-processing device 1c is a caller and ~~second information-processing device 2~~the second information-processing

device 2c is a callee.   Still, the action to determine an IP address in

~~first information-processing device 1~~the first information-processing

20   device 1c is the same as that of the concrete example in embodiment 4,

and thus its description is omitted.

Server 4 transmits ~~an~~ the IP address of ~~second information-processing device 2~~the second information-processing

device 2c to ~~first information-processing device 1~~the first

25   information-processing device 1c, according to a request from ~~first information-processing device 1~~the first information-processing device

1c, and also transmits information showing that ~~first~~

~~information-processing device 1~~<u>the first information-processing device</u>
<u>1</u>c is requesting tunnel communication with ~~second~~
~~information-processing device 2~~<u>the second information-processing</u>
<u>device 2</u>c, to ~~second information-processing device 2~~<u>the second</u>

5   <u>information-processing device 2</u>c.

    Tunnel communication part 22 of ~~second information-processing~~
~~device 2~~<u>the second information-processing device 2</u>c, when receiving
information transmitted from its ~~server 4~~<u>the server 4</u>, ~~judges~~
<u>determines</u> that tunnel communication is to be started (S301), and

10   ~~judgement~~ <u>judgment</u> part 27 ~~judges~~ <u>determines</u> that ~~second~~
~~information-processing device 2~~<u>the second information-processing</u>
<u>device 2</u>c is a callee (S302).   Consequently, ~~address determination part~~
~~26~~<u>the address determination part 26</u>c determines an address in the
same way as in the concrete example in embodiment 4 (S303).   Here, it

15   is assumed that the IP address "192.168.0.2" of ~~second~~
~~information-processing device 2~~<u>the second information-processing</u>
<u>device 2</u>c has been determined by ~~address determination part 26~~<u>the</u>
<u>address determination part 26</u>c, and that the IP address "192.168.0.1"
of ~~first information-processing device 1~~<u>the first information-processing</u>

20   <u>device 1</u>c has been determined.

    The action in which tunnel communication is performed after this
address determination is the same as that in the concrete example in
embodiment 4, except that an address is not transmitted, and thus its
description is omitted.

25   As mentioned above, in the communication system according to
this embodiment, respective information-processing devices can also
determine an address used for communication target data in tunnel

communication, according to a determination whether the
information-processing device is a caller or callee.   Each
information-processing device determines its own address, thus
dispensing with transmitting an address, bringing the same effect as
5   that in embodiment 2.

In this embodiment, the description is made for a case where the
addresses of a communication source and destination are determined
by each information-processing device.   However, if only the address
of ~~first information-processing device 1~~<u>the first information-processing</u>
10   <u>device 1</u>c is determined by itself, and when only the address of ~~second~~
~~information-processing device 2~~**<u>the second information-processing</u>**
<u>device 2</u>c is determined by itself, for example, they may be passed to
the other party's information-processing device directly or indirectly.
(Embodiment 6)

15   A description is made for a communication system according to
embodiment 6 of the present invention, referring to drawings.   In the
communication system according to this embodiment, an address used
for communication target data in tunnel communication is determined
by a server, according to a determination whether the
20   information-processing device is a caller or callee.

Fig. 17 shows the makeup of the communication system according
to this embodiment.   The communication system according to this
embodiment is equipped with ~~first information-processing device 5~~<u>the</u>
<u>first information-processing device 5</u>, ~~second information-processing~~
25   ~~device 6~~<u>the second information-processing device 6</u>, and ~~server 7~~<u>the</u>
<u>server 7</u>d, all connected one another via ~~communication line 3~~<u>the</u>
<u>communication line 3</u>.   Here, ~~first information-processing device 5~~<u>the</u>

first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6 are the same as those in embodiment 3, and thus their descriptions are omitted.

5   Server 7d performs a process to establish tunnel communication performed between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, in the same way as ~~server 4~~the server 4 in embodiment 1, and also determines an address

10   used in the tunnel communication, equipped with a communication control unit 71, an address determination part 73d, an address transmitter 74, and a ~~judgement~~ judgment part 75. Here, the communication control unit 71 and the address transmitter 74 are the same as those in embodiment 3, and thus their descriptions are

15   omitted.

Address determination part 73d determines a first address of ~~first information-processing device 5~~the first information-processing device 5 and a second address of ~~second information-processing device 6~~the second information-processing device 6, both used for communication

20   target data in tunnel communication encapsulated in tunnel communication performed between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, according to a determination judged by ~~judgement~~the

25   judgment part 75. The method of determining an address is the same as that by ~~address determination part 14~~the address determination part 14b in embodiment 4, and thus its description is omitted.

~~Jjudgement~~ <u>The judgment</u> part 75 ~~judges~~ <u>determines</u> which is a caller or callee, tunnel communication performs ~~first information-processing device 5~~<u>the first information-processing device 5</u> or ~~second information-processing device 6~~<u>the second </u>

5 <u>information-processing device 6</u>.   It is sufficient if ~~first information-processing device 5~~<u>the first information-processing device 5</u> and ~~second information-processing device 6~~<u>the second </u><u>information-processing device 6</u> are judged as a caller or callee in this determination.   In other words, ~~first information-processing device~~

10 ~~5~~<u>the first information-processing device 5</u> may be judged as a caller or callee by judging whether ~~second information-processing device 6~~<u>the </u><u>second information-processing device 6</u> is a caller or callee. Alternatively, ~~judgement~~ <u>determination</u> may be made for both ~~first information-processing device 5~~<u>the first information-processing device </u>

15 <u>5</u> and ~~second information-processing device 6~~<u>the second </u><u>information-processing device 6</u>.

Next, a description is made for the action of a communication system, in particular, the action for determining an address, according to this embodiment.   Fig. 18 is a flowchart showing the action to

20 determine an address by ~~server 7~~<u>the server 7</u>d.

(S401) Communication control unit 71 ~~judges~~ <u>determines</u> whether tunnel communication is to be started between ~~first information-processing device 5~~<u>the first information-processing device </u><u>5</u> and ~~second information-processing device 6~~<u>the second </u>

25 <u>information-processing device 6</u>.   If started, the flow goes to S402; otherwise, repeats process S401 until tunnel communication is started.

(S402) ~~judgement~~ <u>judgment</u> part 75 ~~judges~~ <u>determines</u> whether

each of ~~first information-processing device 5~~the first
information-processing device 5 and second information-processing
device is a caller or callee.

(S403) Address determination part 73d determines addresses of

5   ~~first information-processing device 5~~the first information-processing
device 5 and ~~second information-processing device 6~~the second
information-processing device 6, both used for communication target
data in tunnel communication, according to a determination judged by
~~judgement~~ the judgment part 75.

10   (S404) Address transmitter 74 transmits two addresses
determined by the address determination part 73d, to ~~first
information-processing device 5~~the first information-processing device
5 and ~~second information-processing device 6~~the second
information-processing device 6, and then the flow returns to S401.

15   In the flowchart of Fig. 18, the process ends with an interruption
of power off or process end.

Next, a description is made for the action of the communication
system according to this embodiment, using a concrete example.   First,
the data structure in tunnel communication is the same as in Fig. 5.

20   Also, the IP addresses and device identifiers of the
information-processing devices and a server are assumed to be the
same as those in the concrete example in embodiment 3.   Further, the
processes in which ~~first information-processing device 5~~the first
information-processing device 5 and ~~second information-processing~~

25   ~~device 6~~the second information-processing device 6 register their IP
addresses and device identifying information to ~~server 7~~a server 7d are
the same as in embodiment 3, respectively, and thus their descriptions

are omitted.

Next, ~~tunnel communication part 52~~the tunnel communication part 52 of ~~first information-processing device 5~~the first information-processing device 5 transmits to ~~server 7~~the server 7d, a second device identifier for identifying ~~second information-processing device 6~~the second information-processing device 6, and a request to perform tunnel communication with ~~second information-processing device 6~~the second information-processing device 6.   Consequently, the information is received by the communication control unit 71.

Communication control unit 71 ~~judges~~ determines that tunnel communication is to be started (S401), acquires an IP address of ~~first information-processing device 5~~the first information-processing device 5 from the header of a packet transmitted from ~~first information-processing device 5~~the first information-processing device 5, refers to the address identifier correspondence information shown in Fig. 11, and acquires the first device identifier "12345678" of ~~first information-processing device 5~~the first information-processing device 5.   Communication control unit 71 also acquires the IP address "131.206.10.240" corresponding to the device identifier "98765432" transmitted from ~~first information-processing device 5~~the first information-processing device 5, referring to the address identifier correspondence information shown in Fig. 11.   Communication control unit 71 then transmits the IP address "131.206.10.240" of ~~second information-processing device 6~~the second information-processing device 6 to ~~first information-processing device 5~~the first information-processing device 5.

~~Judgement~~ Judgment part 75, because the communication control

unit 71 has received information transmitted from ~~first information-processing device 5~~the first information-processing device 5, requesting tunnel communication with ~~second information-processing device 6~~the second information-processing device 6, ~~judges~~ determines that ~~first information-processing device 5~~the first information-processing device 5 is a caller and ~~second information-processing device 6~~the second information-processing device 6 is a callee (S402).   ~~Judgement~~ Judgment part 75 then passes to the address determination part 73d, information showing that the information-processing device identified by the device identifier "12345678" is a caller, and "98765432" is a callee.   Consequently, address determination part 73d determines an address according to the determination and passes the determined address along with its device identifier ~~to~~to the ~~–~~address transmitter 74 (S403).   Here, this method of determining an address is the same as that in the concrete example in embodiment 4, and thus its description is omitted.

Address transmitter 74, when receiving from the address determination part 73d a set of the device identifier "12345678" and its corresponding IP address "192.168.0.1", and a set of the device identifier "98765432" and its corresponding IP address "192.168.0.2", acquires the IP addresses of the information-processing devices corresponding to the respective device identifiers, referring to address identifier correspondence information retained in the communication control unit 71.   Then, the address transmitter 74 transmits the two sets of the device identifiers and IP addresses to the IP address "202.132.10.6" of ~~first information-processing device 5~~the first information-processing device 5 and "131.206.10.240" of ~~second~~

~~information-processing device 6~~the second information-processing device 6 (S404).   The processes hereafter are the same as those in the concrete example in embodiment 3, and thus their descriptions are omitted.

5   As mentioned above, in the communication system according to this embodiment, ~~server 7~~the server 7d can determine an address used for communication target data in tunnel communication performed between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, according to a

10   determination whether information-processing device is a caller or callee.   This enables an address to be easily determined with a simple deterministic algorithm.

In this embodiment, the description is made for a case where the address transmitter 74 transmits an address determined by the

15   address determination part 73d.   However, an address output part for outputting an address determined by the address determination part 73d may be equipped instead of the address transmitter 74.   Here, this output may be, for example, display on a display device (e.g. CRT

20   or liquid crystal display), transmission to a given device via communication lines, printing by a printer, recording on a given recording medium, or sound output by a speaker.   The address output part may optionally include an output device (e.g. display device or printer).   Also, the address output part may be implemented with

25   hardware, or software such as a driver for driving such a device.   The address having been output may be set in ~~first information-processing device 5~~the first information-processing device 5 or ~~second~~

~~information-processing device 6~~the second information-processing device 6, for example, by being recorded on a given recording medium, or alternatively by being sent to the user of ~~second information-processing device 6~~the second information-processing

5   device 6 by the administrator of ~~server 7~~the server 7 via email, facsimile, or others.

In this embodiment, the description is made for a case where the address transmitter 74 of ~~server 7~~the server 7d transmits to ~~second information-processing device 6~~the second information-processing

10   device 6, two addresses determined by the address determination part 73d.   However, ~~server 7~~the server 7d may first transmit the address "192.168.0.1" of ~~first information-processing device 5~~the first information-processing device 5 to ~~first information-processing device 5~~the first information-processing device 5, and "192.168.0.2" of ~~second information-processing device 6~~the second information-processing

15   device 6 to ~~second information-processing device 6~~the second information-processing device 6, and then transmit the address of the other party, when an inquiry related to the address of the other party in tunnel communication is made from an information-processing

20   device.

(Embodiment 7)

A description is made for a communication system according to embodiment 7 of the present invention, referring to drawings.   The communication system according to this embodiment determines an

25   address used for communication target data in tunnel communication, according to the device identifier of an information-processing device and a tunnel communication identifier for identifying tunnel

communication.

The communication system according to this embodiment is assumed to be the same as that in Fig. 1, where ~~first information-processing device 1~~the first information-processing device

5   1 is assumed to correspond to ~~first information-processing device 1~~the first information-processing device 1e, and ~~server 4~~the server 4 to correspond to ~~server 4~~the server 4e.   In addition, ~~second information-processing device 2~~**the second information-processing device 2** is assumed to correspond to ~~second information-processing~~

10   ~~device 2~~**the second information-processing device 2**b in embodiment 4.

Fig. 19 is a block diagram showing the makeup of ~~first information-processing device 1~~the first information-processing device 1e according to this embodiment.   ~~First information-processing device 1~~The first information-processing device 1e according to this

15   embodiment is equipped with ~~tunnel communication part 11~~the tunnel communication part 11, ~~identifier acceptor 12~~the identifier acceptor 12, ~~identifier storage part 13~~the identifier storage part 13, ~~address determination part 14~~the address determination part 14e, the address transmitter 15, and the tunnel communication identifier acceptor 17.

20   Here, ~~tunnel communication part 11~~the tunnel communication part 11, ~~identifier acceptor 12~~the identifier acceptor 12, ~~identifier storage part 13~~the identifier storage part 13, ~~address transmitter 15~~**the address transmitter 15** are the same as those in embodiment 1, and thus their descriptions are omitted.

25   Address determination part 14e determines an address used for communication target data encapsulated in tunnel communication, according to a communication destination device identifier accepted by

~~identifier acceptor 12~~the identifier acceptor 12, a communication

source device identifier stored in ~~identifier storage part 13~~the

identifier storage part 13, and a tunnel communication identifier

accepted by the tunnel communication identifier acceptor 17.   Here, ~~a~~

5   the tunnel communication identifier refers to an identifier for

identifying tunnel communication performed between

information-processing devices.   It is sufficient if the address used in

a device for communication destination (i.e. ~~second~~

~~information-processing device 2~~**the second information-processing**

10   **device 2**b) and that for communication source (i.e. ~~first~~

~~information-processing device 1~~the first information-processing device

1e) are different each other in this address determination.   Methods of

determining an address include one with a given function used, and

one by selecting from a plurality of predetermined addresses.   In

15   addition, ~~address determination part 14~~the address determination part

14e may determine a part of an address used for communication target

data, according to a communication destination device identifier and

communication source device identifier; the other part of the address

used for the communication target data, according to a tunnel

20   communication identifier.   A concrete example of a method of

determining an address is described hereinafter.   In determining

addresses, an address for a device for communication source and/or one

for communication destination may be determined.   In this

embodiment, a description is made for a case where both addresses for

25   a communication source and communication destination are

determined.

Tunnel communication identifier acceptor 17 accepts a tunnel

communication identifier.   Tunnel communication identifier acceptor
17 may, for example, receive a tunnel communication identifier
transmitted (from ~~server 4~~the server 4e, for example) via wired or
wireless communication lines, may accept a tunnel communication

5   identifier having been input to ~~first information-processing device 1~~the
first information-processing device 1e through a given input device (e.g.
keyboard, mouse, or touch panel), may accept a tunnel communication
identifier read from a given recording medium (e.g. optical disc,
magnetic disk, or semiconductor memory), or may accept a tunnel

10   communication identifier generated by ~~first information-processing~~
~~device 1~~the first information-processing device 1e.   In this
embodiment, a description is made for a case where accepting a tunnel
communication identifier transmitted from ~~server 4~~the server 4e.
Here, the tunnel communication identifier acceptor 17 may optionally

15   include a device for accepting (e.g. modem or network card).   Also, the
tunnel communication identifier acceptor 17 may be implemented by
means of hardware, or software such as a driver for driving a given
device.

       Fig. 20 is a block diagram showing the makeup of ~~server 4~~the
20   server 4e according to this embodiment.   Server 4e is equipped with a
tunnel communication identifier generation part 41, a tunnel
communication identifier transmitter 42, and a communication control
unit 71.   Here, the communication control unit 71 is the same as that
in embodiment 3, and thus its description is omitted.

25   Tunnel communication identifier generation part 41 generates a
tunnel communication identifier.   If this tunnel communication
identifier can identify tunnel communication performed among a

plurality of information-processing devices, that is sufficient.

Therefore, a tunnel communication identifier may be a GUID (Globally

Unique Identifier), for example, or may be reused for other tunnel

communication after the current one ends.   Tunnel communication

5   identifier generation part 41 may generate a tunnel communication

identifier by means of calculation or the like using a given function or

the like, or by means of selecting from a table including a plurality of

tunnel communication identifiers.   However, as long as a tunnel

communication identifier capable of identifying tunnel communication

10   can be determined, whatever method may be used.

Tunnel communication identifier transmitter 42 transmits a

tunnel communication identifier generated by the tunnel

communication identifier generation part 41, to an

information-processing device performing tunnel communication

15   identified by the tunnel communication identifier.   Here, the tunnel

communication identifier transmitter 42, for example, may transmit a

tunnel communication identifier to only devices that determine an

address, or to all devices that perform tunnel communication.   In this

embodiment, a description is made for a case where a tunnel

20   communication identifier is transmitted to only devices that determine

an address.   In addition, the tunnel communication identifier

transmitter 42 may optionally include a transmission device for

transmitting (e.g. modem or network card).   In this case, a

transmission device (not illustrated) is to exist between ~~tunnel~~

25   ~~communication identifier transmitter~~**the tunnel communication**

identifier transmitter 42 and ~~communication line 3~~the communication

line 3.   Also, ~~tunnel communication identifier transmitter~~the tunnel

communication identifier transmitter 42 may be implemented by means of hardware, or software such as a driver for driving such a given device.

Next, a description is made for the action of a communication

5   system, in particular, the action in which an address is determined by ~~first information-processing device 1~~the first information-processing device 1e, according to this embodiment.   Fig. 21 is a flowchart showing the action in which an address is determined by ~~first information-processing device 1~~the first information-processing device

10   1e.

(S501) Identifier acceptor 12 ~~judges~~ determines whether a communication destination device identifier has been accepted.   If accepted, the flow goes to S502; otherwise, to S503.

(S502) Address determination part 14e temporarily stores a

15   communication destination device identifier (not illustrated) accepted by ~~identifier acceptor 12~~the identifier acceptor 12 in a recording medium, and then the flow returns to S501.

(S503) Tunnel communication identifier acceptor 17 ~~judges~~ determines whether a tunnel communication identifier has been

20   accepted.   If accepted, the flow goes to S504; otherwise, to S505.

(S504) Address determination part 14e temporarily stores a tunnel communication identifier (not illustrated) accepted by ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 17 in a recording medium, and then the flow returns to S501.

25   (S505) Address determination part 14e ~~judges~~ determines whether the communication destination device identifier and tunnel communication identifier have been accepted.   This ~~judgement~~

judgment is made, for example, by whether the communication destination device identifier and tunnel communication identifier are stored in a recording medium (not illustrated) included in ~~address determination part 14~~the address determination part 14e.   If accepted, the flow goes to S506; otherwise, returns to S501.

(S506) Address determination part 14e determines an address using a communication destination device identifier and a tunnel communication identifier, temporarily stored in a recording medium (not illustrated), and a communication source device identifier stored in ~~identifier storage part 13~~the identifier storage part 13.   This method of determining an address is described hereinafter.

(S507) Address transmitter 15 transmits an address determined by ~~address determination part 14~~the address determination part 14e to ~~second information-processing device 2~~**the second information-processing device 2**b, and the flow returns to S501.

In the flowchart of Fig. 21, the process ends with an interruption of power off or process end.   In addition, this flowchart illustrates a case where actions such as an address determination are performed when judged that communication destination device identifier and tunnel communication identifier have been accepted.   However, such timing is not limited to this case, but actions such as an address determination may be performed, for example, when ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 17 accepts a tunnel communication identifier.   In addition, if a communication destination device identifier has not been accepted when a tunnel communication identifier is accepted, a request may be made for transmission and input of a communication destination

device identifier, for example.   Further, this flowchart illustrates a

case where the accepted communication destination device identifier

and tunnel communication identifier are temporarily stored in a

recording medium (not illustrated) included in ~~address determination~~

5   ~~part 14~~<u>the address determination part 14</u>e.   However, the accepted

communication destination identifier and others may be temporarily

stored in another recording medium.   Still, this flowchart illustrates

only a process for determining an address; however, it is obvious that

this determined address is used for tunnel communication.

10   Next, a description is made for the action of the communication

system according to this embodiment, using a concrete example.   First,

the data structure in tunnel communication is the same as that in Fig.

5 in embodiment 1.   Also, the IP addresses and device identifiers of an

information-processing device and a server are assumed to be the same

15   as those in the concrete example in embodiment 1.   Further, the

processes in which ~~first information-processing device 1~~<u>the first</u>

<u>information-processing device 1</u>e and ~~second information-processing~~

~~device 2~~**<u>the second information-processing device 2</u>**b respectively

register IP addresses and device identifying information to ~~server 4~~<u>the</u>

20   <u>server 4</u>e are the same as those in embodiment 1, and thus their

descriptions are omitted.

When a detachable recording medium with a communication

destination device identifier recorded therein is attached to ~~first~~

~~information-processing device 1~~<u>the first information-processing device</u>

25   <u>1</u>e, it is assumed that the communication destination device identifier

"98765432" stored in the recording medium has been accepted by

~~identifier acceptor 12~~<u>the identifier acceptor 12</u>, and is passed to ~~tunnel~~

~~communication part 11~~the tunnel communication part 11 and ~~address determination part 14~~the address determination part 14e (S501).

Address determination part 14e temporarily stores the communication destination device identifier in a memory (not illustrated) (S502).

5   Tunnel communication part 11, when receiving the communication destination device identifier "98765432" from ~~identifier acceptor 12~~the identifier acceptor 12, ~~judges~~ determines that tunnel communication is to be started, and transmits to ~~server 4~~the server 4e, the received communication destination device identifier and an instruction of

10   transmitting an IP address of a device identified by the communication destination device identifier.   Consequently, ~~server 4~~the server 4e receives them and transmits the retained IP address "131.206.10.240" corresponding to the communication destination device identifier "98765432" to ~~first information-processing device 1~~the first

15   information-processing device 1e.   Tunnel communication part 11 of ~~first information-processing device 1~~the first information-processing device 1e, when accepting the IP address "131.206.10.240" of ~~second information-processing device 2~~**the second information-processing device 2**b from ~~server 4~~the server 4e, retains the IP address.

20   In addition, ~~server 4~~the server 4e ~~judges~~ determines that tunnel communication is to be started between ~~first information-processing device 1~~the first information-processing device 1e and ~~second information-processing device 2~~**the second information-processing device 2**b.   Then, tunnel communication identifier generation part 41

25   generates a tunnel communication identifier "111222333" for determining tunnel communication performed between ~~first information-processing device 1~~the first information-processing device

<u>1</u>e and ~~second information-processing device 2~~**the second**

information-processing device 2b.   Tunnel communication identifier

transmitter 42 transmits the tunnel communication identifier to ~~first~~

~~information-processing device 1~~<u>the first information-processing device</u>

<u>1</u>e that is a caller, and that determines an address.   The address of

~~first information-processing device 1~~<u>the first information-processing</u>

<u>device 1</u>e is one acquired from the header of a packet including a

communication destination device identifier transmitted from ~~first~~

~~information-processing device 1~~<u>the first information-processing device</u>

<u>1</u>e.   The transmitted tunnel communication identifier "111222333" is

accepted by ~~tunnel communication identifier acceptor~~**the tunnel**

communication identifier acceptor 17 of ~~first information-processing~~

~~device 1~~<u>the first information-processing device 1</u>e (S503).   The tunnel

communication identifier is passed to ~~address determination part~~

~~14~~<u>the address determination part 14</u>e.   Address determination part

14e temporarily stores in a memory (not illustrated) a tunnel

communication identifier accepted from ~~tunnel communication~~

~~identifier acceptor~~**the tunnel communication identifier acceptor** 17

(S504).

     After that, ~~address determination part 14~~<u>the address</u>

<u>determination part 14</u>e ~~judges~~ <u>determines</u> that communication

destination device identifier and tunnel communication identifier have

been accepted (S505), and determines an IP address used for

communication target data in tunnel communication, according to the

communication destination device identifier "98765432" and the tunnel

communication identifier "111222333", temporarily stored in a memory

(not illustrated) included in ~~address determination part 14~~<u>the address</u>

determination part 14e, , and the communication source device identifier "12345678" read from ~~identifier storage part 13~~the identifier storage part 13.   Specifically, ~~address determination part 14~~the address determination part 14e determines an address with one of the following three methods, for example (S506).

[Method of Determining an Address Using a Table]

The address determined by ~~address determination part 14~~the address determination part 14e has a structure shown in Fig. 22A. That is, the first eight bits show "169", and next eight bits, "254".   The first 12 bits of the further next 16 bits indicate a network address, which uses a remainder after dividing a tunnel communication identifier by "4,096".   The last four bits show a host address, which is determined using the table of Fig. 22B.   The table of Fig. 22B shows correspondence between a digit number where the device identifier is different and its host address.   Address determination part 14e determines a host address corresponding to the values ("2" and "8") of the least significant digits of the communication destination device identifier "98765432" and communication source device identifier "12345678", using the table of Fig. 22B.   Consequently, the host address of ~~first information-processing device 1~~the first information-processing device 1e is "8", and that of ~~second information-processing device 2~~the second information-processing device 2b is "2".   The remainder "3645", after dividing the tunnel communication identifier "111222333" by "4,096", is a network address common to ~~first information-processing device 1~~the first information-processing device 1e and ~~second information-processing device 2~~the second information-processing device 2b.   Therefore,

~~address determination part 14~~the address determination part 14e determines the IP address of ~~first information-processing device 1~~the first information-processing device 1e as "169.254.227.216". ("111000111101", which is binary notation for "3645", and "1000", which is binary notation for "8", are divided into eight bits each, "11100011" and "11011000". They are "227" and "216", respectively in decimal notation.) In the same way, ~~address determination part 14~~the address determination part 14e determines the IP address of ~~second information-processing device 2~~**the second information-processing device 2**b as "169.254.227.210". Then, ~~address determination part 14~~the address determination part 14e passes these addresses to ~~tunnel communication part 11~~the tunnel communication part 11 and ~~address transmitter 15~~**the address transmitter 15**. Here, if the addresses are determined in this way, "255.255.255.248" is used as a subnet mask in each information-processing device. As in this way where an address is determined using a table, ~~address determination part 14~~the address determination part 14e may determine a part of ~~an~~the address according to a communication destination device identifier and communication source device identifier, and may determine the other part of the address according to a tunnel communication identifier.

[Method of Determining an Address Using a Function]

Address determination part 14e has the function "Func(argument 1, argument 2, argument 3)" for determining an address. The communication source device identifier "12345678" is substituted for argument 1, the communication destination device identifier "98765432" for argument 2, and the tunnel communication identifier "111222333" for argument 3. Consequently, the two addresses

"192.168.0.1" and "192.168.0.2" are derived.   Then, the former IP address is determined as that of ~~first information-processing device 1~~the first information-processing device 1e, and the latter as ~~second information-processing device 2~~**the second information-processing**

5   **device 2**b.   Next, ~~address determination part 14~~the address determination part 14e passes these addresses to ~~tunnel communication part 11~~the tunnel communication part 11 and ~~address transmitter 15~~**the address transmitter 15**.

[Method of Determining an Address according to Magnitude

10   Comparison Between Device Identifiers]

In this method also, an address determined by ~~address determination part 14~~the address determination part 14e is assumed to have the structure shown in Fig. 22A.   In addition, the method of determining a network address according to a tunnel communication

15   identifier is assumed to be the same as "a method of determining an address using a table" aforementioned.   Address determination part 14e is to allocate "2" to the host address of the information-processing device with the larger device identifier; "1", to the smaller.   Therefore, the host address of ~~first information-processing device 1~~the first

20   information-processing device 1e is to be "1" because the device identifier "12345678" of ~~first information-processing device 1~~the first information-processing device 1e is smaller than the device identifier "98765432" of ~~second information-processing device 2~~**the second information-processing device 2**b.   Consequently, ~~address~~

25   ~~determination part 14~~the address determination part 14e determines the IP address of ~~first information-processing device 1~~the first information-processing device 1e as "169.254.227.209".   Also, ~~address~~

~~determination part 14~~the address determination part 14e determines

the IP address of ~~second information-processing device 2~~**the second**

information-processing device 2b as "169.254.227.210".   Then ~~address~~

~~determination part 14~~the address determination part 14e passes these

5   addresses to ~~tunnel communication part 11~~the tunnel communication

part 11 and ~~address transmitter 15~~**the address transmitter 15**.   Also

in this case, "255.255.255.248" is to be used as a subnet mask in each

information-processing device.

Hereinbefore, three different methods of determining an address

10   are described.   However, it is sufficient if ~~address determination part~~

~~14~~the address determination part 14e determines an address according

to a communication source device identifier, communication

destination device identifier, and tunnel communication identifier, and

thus an address may be determined with a method of determining an

15   address other than these.

Address transmitter 15, in the same way as in the concrete

example in embodiment 1, transmits the determined IP addresses of

~~first information-processing device 1~~the first information-processing

device 1e and ~~second information-processing device 2~~**the second**

20   **information-processing device 2**b, to ~~second information-processing~~

~~device 2~~the second information-processing device 2b (S507).

Consequently, these IP addresses are accepted by ~~address acceptor~~

~~21~~the address acceptor 21 in ~~second information-processing device 2~~the

second information-processing device 2b and passed to ~~tunnel~~

25   ~~communication part 22~~**the tunnel communication part 22**.   Further,

~~tunnel communication part 11~~the tunnel communication part 11, in the

same way as in the concrete example in embodiment 1, performs tunnel

communication using the determined address, and so does ~~tunnel communication part 22~~**the tunnel communication part 22** using the address accepted by ~~address acceptor 21~~**the address acceptor 21**.

As mentioned above, the communication system according to this
5   embodiment can determine an address used for communication target data in tunnel communication, according to the device identifier of an information-processing device performing tunnel communication, and a tunnel communication identifier for identifying tunnel communication, which is a deterministic algorithm, simpler than a
10   heuristic one.   Consequently, this embodiment has the same advantage as embodiment 1.

In this embodiment, the description is made for a structure where ~~first information-processing device 1~~**the first information-processing device 1**e has ~~address transmitter 15~~**the address transmitter 15**.
15   However, ~~first information-processing device 1~~**the first information-processing device 1**e may have an address output part for outputting an address determined by ~~address determination part 14~~**the address determination part 14**e, instead of ~~address transmitter 15~~**the address transmitter 15**.   Here, this output may be, for example,
20   display on a display device (e.g. CRT or liquid crystal display), transmission to a given device via communication lines, printing by a printer, recording on a given recording medium, or sound output by a speaker.   The address output part may optionally include an output device (e.g. display device or printer).   Also, the address output part
25   may be implemented with hardware, or software such as a driver for driving such a device.   The address having been output may be set in ~~second information-processing device 2~~**the second**

information-processing device 2b, for example, by being recorded on a given recording medium, or by being sent to the user of ~~second information-processing device 2~~**the second information-processing device 2**b via email, facsimile, or the like

5   In this embodiment, a tunnel communication identifier generated by ~~server 4~~the server 4e is transmitted only to ~~first information-processing device 1~~the first information-processing device 1e.   However, the tunnel communication identifier may be transmitted to ~~second information-processing device 2~~the second **information-processing device 2**b as well as to ~~first information-processing device 1~~the first information-processing device 1e.

(Embodiment 8)

          A description is made for a communication system according to

15   embodiment 8 of the present invention, referring to drawings.   In the communication system according to this embodiment, respective information-processing devices determine an address used for communication target data in tunnel communication, according to a device identifier of each information-processing device and a tunnel

20   communication identifier.

          Fig. 23 shows the makeup of the communication system according to this embodiment.   The communication system according to this embodiment is equipped with ~~first information-processing device 1~~the first information-processing device 1f, ~~second information-processing~~

25   ~~device 2~~**the second information-processing device 2**f, and ~~server 4~~the server 4e.   Server 4e is the same as that in embodiment 7, and thus its descriptions is omitted.   However in this embodiment, ~~server 4~~the

server 4e is assumed to transmit the generated tunnel communication identifier to both ~~first information-processing device 1~~the first information-processing device 1f and ~~second information-processing device 2~~the second information-processing device 2f, because addresses

5   are determined by ~~first information-processing device 1~~the first information-processing device 1f and ~~second information-processing device 2~~the second information-processing device 2f.

~~First information-processing device 1~~The first information-processing device 1f is equipped with ~~tunnel communication part 11~~the tunnel communication part 11, ~~identifier~~

10 ~~acceptor 12~~the identifier acceptor 12, ~~identifier storage part 13~~the identifier storage part 13, ~~address determination part 14~~the address determination part 14e, and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 17.   Here,

15 ~~tunnel communication part 11~~the tunnel communication part 11, ~~identifier acceptor 12~~the identifier acceptor 12, ~~identifier storage part 13~~the identifier storage part 13, ~~address determination part 14~~the address determination part 14e, and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 17 are the same

20 as those in embodiment 7, and thus their descriptions are omitted.

Second information-processing device 2f is equipped with ~~tunnel communication part 22~~the tunnel communication part 22, ~~identifier storage part 23~~the identifier storage part 23, ~~identifier acceptor 25~~the identifier acceptor 25, ~~address determination part 26~~the address

25 determination part 26f, and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 28.   Here, ~~tunnel communication part 22~~the tunnel communication part 22 is the

same as that in embodiment 4; ~~identifier storage part 23~~the identifier storage part 23 and ~~identifier acceptor 25~~the identifier acceptor 25 are the same as those in embodiment 2; and ~~address determination part 26~~the address determination part 26f and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 28 are

5   the same as ~~address determination part 14~~the address determination part 14e and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 17 in embodiment 7, respectively, and thus their descriptions are omitted.

10   In addition, the action to determine an address in ~~first information-processing device 1~~the first information-processing device 1f is the same as shown in Fig. 21 in embodiment 7, except that the address transmission process at S507 is not performed, and thus its description is omitted.   Also, the action to determine an address in

15   ~~second information-processing device 2~~the second information-processing device 2f is the same as shown in Fig. 21 in embodiment 7, except that ~~tunnel communication part 11~~the tunnel communication part 11, ~~identifier acceptor 12~~the identifier acceptor 12, ~~identifier storage part 13~~the identifier storage part 13, ~~address determination part 14~~the address determination part 14e, and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 17 correspond to ~~tunnel communication part 22~~the tunnel communication part 22, ~~identifier acceptor 25~~the identifier acceptor 25, ~~identifier storage part 23~~the identifier storage part 23, ~~address determination part 26~~the address determination part 26f, and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 28, respectively, and that the address transmission process at

S507 is not performed, and thus their descriptions are omitted.

Next, a description is made for the action of the communication system according to this embodiment, using a concrete example. Here, the action in which an IP address is determined in ~~first information-processing device 1~~the first information-processing device 1f is the same as that in the concrete example in embodiment 7, and thus its description is omitted. Still, as aforementioned, a tunnel communication identifier is assumed to be transmitted to ~~second information-processing device 2~~**the second information-processing device 2**f as well as to ~~first information-processing device 1~~the first information-processing device 1f.

Server 4e transmits the IP address of ~~second information-processing device 2~~**the second information-processing device 2**f to ~~first information-processing device 1~~the first information-processing device 1f, according to a request from ~~first information-processing device 1~~the first information-processing device 1f, while transmitting a device identifier of ~~first information-processing device 1~~the first information-processing device 1f and information showing that ~~first information-processing device 1~~the first information-processing device 1f is requesting tunnel communication with ~~second information-processing device 2~~**the second information-processing device 2**f, to ~~second information-processing device 2~~the second information-processing device 2f. In addition, ~~server 4~~the server 4e generates a tunnel communication identifier and transmits it to ~~first information-processing device 1~~the first information-processing device 1f and ~~second information-processing device 2~~**the second information-processing device 2**f.

Identifier acceptor 25 of ~~second information-processing device 2~~__the second information-processing device 2__f accepts a device identifier of ~~first information-processing device 1~~__the first information-processing device 1__f transmitted from ~~server 4~~__the server 4__e through ~~tunnel communication part 22~~__the tunnel communication part 22__ (S501).   The device identifier is temporarily stored in a memory (not illustrated) in ~~address determination part 26~~__the address determination part 26__f (S502).   Further, ~~tunnel communication identifier acceptor~~__the tunnel communication identifier acceptor__ 28 of ~~second information-processing device 2~~__the second information-processing device 2__f accepts through ~~tunnel communication part 22~~__the tunnel communication part 22__, a tunnel communication identifier transmitted from ~~server 4~~__the server 4__e (S503).   The tunnel communication identifier is temporarily stored in a memory (not illustrated) of ~~address determination part 26~~__the address determination part 26__f (S504).   After that, ~~address determination part 26~~__the address determination part 26__f ~~judges~~__determines__ that a device identifier and tunnel communication identifier have been accepted (S505), and the IP addresses of ~~first information-processing device 1~~__the first information-processing device 1__f and ~~second information-processing device 2~~__the second information-processing device 2__f are determined, according to a device identifier and a tunnel communication identifier, stored in a memory (not illustrated) of ~~address determination part 26~~__the address determination part 26__f; and a device identifier of ~~second information-processing device 2~~__the second information-processing device 2__f, read from ~~identifier storage part 23~~__the identifier storage part 23__.   These processes are the same as those in embodiment 7, and

thus their descriptions are omitted.

However, if an address is determined using a function, as described in the concrete example in embodiment 2, the device identifier of ~~second information-processing device 2~~<u>the second</u>

5   <u>information-processing device 2</u>f is to be substituted for argument 1, and the device identifier of ~~first information-processing device 1~~<u>the first information-processing device 1</u>f for argument 2.   Further, this function is assumed to reverse the order of the IP addresses if argument 1 and argument 2 are swapped.   In this case, the first

10   address of the addresses determined by ~~address determination part 26~~<u>the address determination part 26</u>f using the function is to be the IP address of ~~second information-processing device 2~~<u>the second information-processing device 2</u>f, and the second to be ~~first information-processing device 1~~<u>the first information-processing device</u>

15   <u>1</u>f.

The action in which tunnel communication is performed after this address determination is the same as that in the concrete example in embodiment 7, except that an address is not transmitted, and thus its descriptions is omitted.

20   As mentioned above, in the communication system according to this embodiment, it is also possible that respective information-processing devices determine an address used for communication target data in tunnel communication, according to a device identifier of the information-processing device and a tunnel

25   communication identifier.   Each information-processing device determines its own address, thus dispensing with transmitting an address, bringing the same effect as that in embodiment 2.

In this embodiment, the description is made for a case where the addresses of a communication source and destination are determined by each information-processing device. However, when only the address of ~~first information-processing device 1~~<u>the first</u>

5   <u>information-processing device 1</u>f is determined by itself, and when only the address of ~~second information-processing device 2~~**the second**

information-processing device 2f is determined by itself, for example, they may be passed to the other party's information-processing device directly or indirectly.

10   (Embodiment 9)

A description is made for a communication system according to embodiment 9 of the present invention, referring to drawings. In the communication system according to this embodiment, a server determines an address used for communication target data in tunnel

15   communication, according to the device identifier and tunnel communication identifier of the information-processing device.

Fig. 24 shows the makeup of the communication system according to this embodiment. In Fig. 24, the communication system according to this embodiment is equipped with ~~first information-processing~~

20   ~~device 5~~<u>the first information-processing device 5</u>, ~~second~~ ~~information-processing device 6~~<u>the second information-processing</u> <u>device 6</u>, and ~~server 7~~<u>the server 7</u>g, all connected one another via ~~communication line 3~~<u>the communication line 3</u>. Here, ~~first~~ ~~information-processing device 5~~<u>the first information-processing device</u>

25   <u>5</u> and ~~second information-processing device 6~~<u>the second</u> <u>information-processing device 6</u> are the same as those in embodiment 3, and thus their descriptions are omitted.

Server 7g, in the same way as ~~server 4~~ the server 4 in embodiment 1,   performs a process to establish tunnel communication performed between ~~first information-processing device 5~~ the first information-processing device 5 and ~~second information-processing device 6~~ the second information-processing device 6, and also

5   determines an address used in the tunnel communication, equipped with a communication control unit 71, an identifier acceptor 72, an address determination part 73g, an address transmitter 74, a tunnel communication identifier generation part 41, and ~~tunnel communication identifier acceptor~~**a tunnel communication identifier**

10   **acceptor** 76.   Here, the communication control unit 71, the identifier acceptor 72, and the address transmitter 74 are the same as those in embodiment 3, and the tunnel communication identifier generation part 41 is the same as that in embodiment 7, and thus their

15   descriptions are omitted.

Address determination part 73g determines a first address of ~~first information-processing device 5~~ the first information-processing device 5 and a second address of ~~second information-processing device 6~~ the second information-processing device 6, both used for communication

20   target data in tunnel communication encapsulated in tunnel communication performed between ~~first information-processing device 5~~ the first information-processing device 5 and ~~second information-processing device 6~~ the second information-processing device 6, according to a first device identifier for identifying ~~first information-processing device 5~~ the first information-processing device

25   5 and a second device identifier for identifying ~~second information-processing device 6~~ the second information-processing

device 6, both accepted by identifier acceptor 72, and to a tunnel communication identifier accepted by ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 76.   The method of determining an address is the same as that by ~~address determination part 14~~**the address determination part 14**e in

5   embodiment 7, and thus its description is omitted.

Tunnel communication identifier acceptor 76 accepts a tunnel communication identifier.   Tunnel communication identifier acceptor 76 may, for example, receive a tunnel communication identifier

10   transmitted (from another server, for example) via wired or wireless communication lines, may accept a tunnel communication identifier having been input to ~~server 7~~**the server 7**g through a given input device (e.g. keyboard, mouse, or touch panel), may accept a tunnel communication identifier read from a given recording medium (e.g.

15   optical disc, magnetic disk, or semiconductor memory), or may accept a tunnel communication identifier generated by ~~server 7~~**the server 7**g. In this embodiment, a description is made for a case where accepting a tunnel communication identifier generated by tunnel communication identifier generation part 41 of ~~server 7~~**the server 7**g.   Here, ~~tunnel~~

20   ~~communication identifier acceptor~~**the tunnel communication identifier acceptor** 76 may optionally include a device for accepting (e.g. modem or network card).   Also, ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 76 may be implemented by means of hardware, or software such as a driver for driving a given

25   device.

Next, a description is made for the action of the communication system, in particular, the action for determining an address, according

to this embodiment.   Fig. 25 is a flowchart showing the action in

which ~~server 7~~ the server 7g determines an address.

(S601) Identifier acceptor 72 ~~judges~~ determines whether the first

device identifier and second device identifier have been accepted.   If

5   accepted, the flow goes to S602; otherwise, process S601 is repeated

until they are accepted.

(S602) Address determination part 73g temporarily stores a first

device identifier and second device identifier accepted by the identifier

acceptor 72 in a recording medium (not illustrated).

10   (S603) Tunnel communication identifier generation part 41

generates a tunnel communication identifier and passes the generated

tunnel communication identifier to ~~tunnel communication identifier~~

~~acceptor~~ the tunnel communication identifier acceptor 76.

(S604) Tunnel communication identifier acceptor 76 accepts the

15   tunnel communication identifier passed from the tunnel

communication identifier generation part 41.

(S605) Address determination part 73g determines an address

according to the tunnel communication identifier accepted by ~~tunnel~~

~~communication identifier acceptor~~ the tunnel communication identifier

20   acceptor 76, and to the first device identifier and second device

identifier, both accepted by the identifier acceptor 72 and temporarily

stored in a recording medium (not illustrated).   This method of

determining an address is the same as that in the concrete example in

embodiment 7, and thus its description is omitted.

25   (S606) Address transmitter 74 transmits the addresses of ~~first~~

~~information-processing device 5~~ the first information-processing device

5 and ~~second information-processing device 6~~ the second

information-processing device 6, both determined by the address

determination part 73g, to ~~first information-processing device 5~~the

first information-processing device 5 and ~~second~~

~~information-processing device 6~~the second information-processing

5   device 6, and then the flow returns to S601.

　　　Here, in the flowchart of Fig. 25, the process ends with an

interruption of power off or process end.　Also, this flowchart

illustrates a case where processes such as determining an address are

performed when the identifier acceptor 72 accepts a first device

10   identifier and others.　However, such a timing is not limited to this

case, but an address may be determined when ~~first~~

~~information-processing device 5~~the first information-processing device

5 and ~~second information-processing device 6~~the second

information-processing device 6 start tunnel communication, using a

15   first device identifier and others having been accepted by the identifier

acceptor 72 by that time, for example.

　　　Next, a description is made for the action of the communication

system according to this embodiment, using a concrete example.　First,

data structure in tunnel communication is the same as that in Fig. 5.

20   In addition, the IP addresses and device identifiers of

information-processing devices and a server are assumed to be the

same as those in the concrete example in embodiment 3.　Further, the

processes in which ~~first information-processing device 5~~the first

information-processing device 5 and ~~second information-processing~~

25   ~~device 6~~the second information-processing device 6 respectively

register the IP addresses and device identifying information to ~~server~~

~~7~~the server 7g are the same as that in embodiment 3, and thus their

description are omitted.

Tunnel communication part 52 of ~~first information-processing device 5~~the first information-processing device 5 transmits a second device identifier for identifying ~~second information-processing device 6~~the second information-processing device 6 and a request for tunnel communication with ~~second information-processing device 6~~the second information-processing device 6, to ~~server 7~~the server 7g.   Then, they are received by the communication control unit 71.   Communication control unit 71 acquires an IP address of ~~first information-processing device 5~~the first information-processing device 5 from the header of a packet transmitted from ~~first information-processing device 5~~the first information-processing device 5, refers to the address identifier correspondence information shown in Fig. 11, and acquires the first device identifier "12345678" of ~~first information-processing device 5~~the first information-processing device 5.   In addition, communication control unit 71 acquires the IP address "131.206.10.240" corresponding to the second device identifier "98765432" transmitted from ~~first information-processing device 5~~the first information-processing device 5, referring to the address identifier correspondence information. Then, the communication control unit 71 passes the first device identifier and the second device identifier to identifier acceptor 72, and also transmits the IP address of ~~second information-processing device 6~~the second information-processing device 6 to ~~first information-processing device 5~~the first information-processing device 5.

Identifier acceptor 72, when accepting the first device identifier and second device identifier from the communication control unit 71

(S601), passes them to <u>the </u>address determination part 73g.   Address determination part 73g temporarily stores the first device identifier and others in a memory (not illustrated) (S602).

    Further, <u>the </u>tunnel communication identifier generation part 41, corresponding to a fact that <u>the </u>communication control unit 71 has received information showing that tunnel communication is to be started, generates a new tunnel communication identifier "111222333" and passes the generated tunnel communication identifier to ~~tunnel communication identifier acceptor~~<u>**the tunnel communication identifier acceptor**</u> 76 (S603).   Consequently, the tunnel communication identifier is accepted by ~~tunnel communication identifier acceptor~~<u>**the tunnel communication identifier acceptor**</u> 76 (S604).

    After that, <u>the </u>address determination part 73g determines IP addresses to be used by ~~first information-processing device 5~~<u>the first information-processing device 5</u> and ~~second information-processing device 6~~<u>the second information-processing device 6</u>, according to the tunnel communication identifier accepted by ~~tunnel communication identifier acceptor~~<u>**the tunnel communication identifier acceptor**</u> 76, and to the first device identifier and second device identifier stored in a memory (not illustrated), and then passes the determined address, making it correspond to the device identifier, to <u>the </u>address transmitter 74 (S605).   This method of determining an address is the same as that in the concrete example in embodiment 7, and thus its description is omitted.

    Address transmitter 74, when receiving a set of the IP address of ~~first information-processing device 5~~<u>the first information-processing device 5</u> determined by address determination part 73g, and the device

identifier of ~~first information-processing device 5~~the first information-processing device 5; and a set of the IP address of ~~second information-processing device 6~~the second information-processing device 6, and the device identifier of the ~~second information-processing device 6~~the second information-processing device 6, refers to the address identifier correspondence information retained by the communication control unit 71 to acquire IP addresses of information-processing devices corresponding to the respective device identifiers.   Then, the address transmitter 74 transmits the two sets of the device identifiers and IP addresses to ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6 (S606).   The processes hereafter are the same as that in the concrete example in embodiment 3, and thus their descriptions are omitted.

As mentioned above, in the communication system according to this embodiment, ~~server 7~~the server 7g can determine an address used for communication target data in tunnel communication performed between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, according to the device identifier of an information-processing device and a tunnel communication identifier.   This enables an address to be easily determined with a simple deterministic algorithm.

In this embodiment, the description is made for a case where the address transmitter 74 transmits an address determined by the address determination part 73g.   However, an address output part for

outputting an address determined by <u>the </u>address determination part 73g may be equipped instead of <u>the </u>address transmitter 74.   Here, this output may be, for example, display on a display device (e.g. CRT or liquid crystal display), transmission to a given device via

5   communication lines, printing by a printer, recording on a given recording medium, or sound output by a speaker.   The address output part may optionally include an output device (e.g. display device or printer).   Also, the address output part may be implemented with hardware, or software such as a driver for driving such a device.   The

10   address having been output may be set in ~~first information-processing device 5~~<u>the first information-processing device 5</u> or ~~second information-processing device 6~~<u>the second information-processing device 6</u>, for example, by being recorded on a given recording medium, or alternatively by being sent to the user of ~~first information-processing device 5~~<u>the first information-processing device</u>

15   <u>5</u> or ~~second information-processing device 6~~<u>the second information-processing device 6</u> by the administrator of ~~server 7~~<u>the server 7g</u> via email, facsimile, or others.

       Further, in this embodiment, the description is made for a case

20   where address transmitter 74 of ~~server 7~~<u>the server 7g</u> transmits two addresses determined by address determination part 73g to ~~second information-processing device 6~~<u>the second information-processing device 6</u>.   However, address transmitter 74 may transmit only the address of ~~second information-processing device 6~~<u>the second</u>

25   <u>information-processing device 6</u> to ~~second information-processing device 6~~<u>the second information-processing device 6</u>.   In this case, ~~second information-processing device 6~~<u>the second</u>

information-processing device 6 can acquire an address of ~~first~~
~~information-processing device 5~~the first information-processing device
5 from the header of encapsulated communication target data
transmitted from ~~first information-processing device 5~~the first
information-processing device 5.

In this embodiment, the description is made for a case where
~~server 7~~the server 7g transmits both the addresses of ~~first~~
~~information-processing device 5~~the first information-processing device
5 and ~~second information-processing device 6~~the second
information-processing device 6.   However, ~~server 7~~the server 7g may
first transmit the address of ~~first information-processing device 5~~the
first information-processing device 5 to ~~first information-processing~~
~~device 5~~the first information-processing device 5, and that of ~~second~~
~~information-processing device 6~~the second information-processing
device 6 to ~~second information-processing device 6~~the second
information-processing device 6, and then transmit the address of the
other party, when an inquiry related to the address of the other party
in tunnel communication is made from an information-processing
device.

(Embodiment 10)

A description is made for a communication system according to
embodiment 10 of the present invention, referring to drawings.   The
communication system according to this embodiment determines an
address used for communication target data in tunnel communication,
according to a determination related to whether the
information-processing device is a caller or callee, and to a tunnel
communication identifier for identifying tunnel communication.

The communication system according to this embodiment is assumed to be the same as that in Fig. 1   However, ~~first-information-processing device 1~~the first information-processing device 1 is assumed to correspond to ~~first information-processing device 1~~the first information-processing device 1h; second information-processing device, to ~~second information-processing device 2~~**the second information-processing device 2**b in embodiment 4; and ~~server 4~~the server 4, to ~~server 4~~the server 4e in embodiment 7.

Fig. 26 is a block diagram showing the makeup of ~~first-information-processing device 1~~the first information-processing device 1h according to this embodiment.   ~~First information-processing device 1~~The first information-processing device 1h according to this embodiment is equipped with ~~tunnel communication part 11~~the tunnel communication part 11, ~~address determination part 14~~the address determination part 14h, ~~address transmitter 15~~**the address transmitter 15**, ~~judgement~~ judgment part 16, and ~~tunnel-communication identifier acceptor~~the tunnel communication identifier acceptor 17.   Here, ~~tunnel communication part 11~~the tunnel communication part 11 and ~~address transmitter 15~~**the address transmitter 15** are the same as those in embodiment 1; ~~judgement~~ judgment part 16, in embodiment 4; and ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 17, in embodiment 7, and thus these descriptions are omitted.

Address determination part 14h determines an address used for communication target data encapsulated in tunnel communication, according to a determination by ~~judgement~~ judgment part 16 and a tunnel communication identifier accepted by ~~tunnel communication-~~

~~identifier acceptor~~__the tunnel communication identifier acceptor__ 17.

Here, tunnel communication identifier refers to an identifier for

identifying tunnel communication performed between

information-processing devices.   In this address determination, it is

5   sufficient if an address used in a device (e.g. ~~second~~

~~information-processing device 2~~__the second information-processing__

__device 2__b) at the communication destination, and that in a device (e.g.

~~first information-processing device 1~~__the first information-processing__

__device 1__h) at the communication source are determined differently,

10   according to a determination by ~~judgement~~ __judgment__ part 16 and a

tunnel communication identifier.   Methods of determining an address

include one with a given function used, and one by selecting from a

plurality of predetermined addresses.   In addition, ~~address~~

~~determination part 14~~__the address determination part 14__h may

15   determine a part of an address used for communication target data,

according to __the__~~a~~ communication destination device identifier and __the__

communication source device identifier; and the other part of the

address used for the communication target data, according to __the__~~a~~

tunnel communication identifier.   A concrete example of a method of

20   determining an address is described hereinafter.   In determining __the__

~~an~~-address, an address for a device for communication source and/or

one for communication destination may be determined.   In this

embodiment, a description is made for a case where both addresses for

a communication source and communication destination are

25   determined.

Next, a description is made for the action of a communication

system, in particular, the action in which ~~first information-processing~~

~~device 1~~the first information-processing device 1h determines an

address, according to this embodiment.   Fig. 27 is a flowchart showing

the action for determining an address in ~~first information-processing~~

~~device 1~~the first information-processing device 1h.

5   (S701) Tunnel communication part 11 ~~judges~~ determines whether

or not to start tunnel communication.   To start this tunnel

communication includes two cases: a case where ~~first~~

~~information-processing device 1~~the first information-processing device

1h actively starts tunnel communication, and a case where tunnel

10   communication starts according to a request from another device

(~~second information-processing device 2~~the second

information-processing device 2b, here).   In either case, ~~tunnel~~

~~communication part 11~~the tunnel communication part 11 ~~judges~~

determines that the tunnel communication is to be started.   If started,

15   the flow goes to S702; otherwise, repeats process S701 until tunnel

communication is started.

          (S702) ~~Judgement~~ Judgment part 16 ~~judges~~ determines whether

~~first information-processing device 1~~the first information-processing

device 1h is a caller or callee.

20   (S703) Tunnel communication identifier acceptor 17 ~~judges~~

determines whether a tunnel communication identifier has been

accepted.   If accepted, the flow goes to S704; otherwise, repeats

process S703 until a tunnel communication identifier is accepted.

          (S704) Address determination part 14h determines an address

25   using a determination by ~~judgement~~ the judgment part 16 and a tunnel

communication identifier accepted by ~~tunnel communication identifier~~

~~acceptor~~the tunnel communication identifier acceptor 17.   This

method of determining an address is described hereinafter.

(S705) Address transmitter 15 transmits the address determined by ~~address determination part 14~~the address determination part 14h to ~~second information-processing device 2~~the second

5   information-processing device 2b, and then the flow returns to S701.

Here, in the flowchart of Fig. 27, the process ends with an interruption of power off or process end.   Still, this flowchart illustrates only a process for determining an address; however, it is obvious that this determined address is used for tunnel

10   communication.

Next, a description is made for the action of the communication system according to this embodiment, using a concrete example.   First, the data structure in tunnel communication is the same as that in Fig. 5 in embodiment 1.   In addition, the IP addresses and device

15   identifiers of information-processing devices and a server are assumed to be the same as those in the concrete example in embodiment 1. Further, the processes in which ~~first information-processing device 1~~the first information-processing device 1h and ~~second information-processing device 2~~the second information-processing

20   device 2b respectively register IP addresses and device identifying information to ~~server 4~~the server 4e are the same as those in embodiment 1, and thus their descriptions are omitted.

It is assumed that a detachable recording medium with a communication destination device identifier recorded therein is

25   attached to ~~first information-processing device 1~~the first information-processing device 1h, and the communication destination device identifier "98765432" stored in the recording medium is

accepted by an acceptor (not illustrated) and is passed to ~~tunnel communication part 11~~the tunnel communication part 11.

Then, ~~tunnel communication part 11~~the tunnel communication part 11 ~~judges~~ determines that tunnel communication is to be started

5   (S701), and transmits to ~~server 4~~the server 4e the received communication destination device identifier and an instruction of transmitting an IP address of a device identified by the communication destination device identifier.   Consequently, ~~server 4~~the server 4e receives them to transmit the retained IP address "131.206.10.240",

10   corresponding to the communication destination device identifier "98765432", to ~~first information-processing device 1~~the first information-processing device 1h.   Tunnel communication part 11 of ~~first information-processing device 1~~the first information-processing device 1h, when accepting the IP address "131.206.10.240" of ~~second information-processing device 2~~**the second information-processing**

15   **device 2**b from ~~server 4~~the server 4e, retains the IP address.

~~Judgement~~ Judgment part 16 ~~judges~~ determines that ~~first information-processing device 1~~the first information-processing device 1h is a caller because ~~tunnel communication part 11~~the tunnel

20   communication part 11 is a caller in communication for a protocol of tunnel in tunnel communication (S702), and then passes the determination to ~~address determination part 14~~the address determination part 14h.

In addition, ~~server 4~~the server 4e ~~judges~~ determines that tunnel

25   communication is started between ~~first information-processing device 1~~the first information-processing device 1h and ~~second information-processing device 2~~**the second information-processing**

device 2b.   Then, tunnel communication identifier generation part 41 generates the tunnel communication identifier "111222333" for identifying tunnel communication performed between ~~first information-processing device 1~~the first information-processing device

5   1h and ~~second information-processing device 2~~the second information-processing device 2b.   Tunnel communication identifier transmitter 42 transmits the tunnel communication identifier to ~~first information-processing device 1~~the first information-processing device 1h.   The address of ~~first information-processing device 1~~the first

10   information-processing device 1h is one acquired from the header of a packet including a communication destination device identifier transmitted from ~~first information-processing device 1~~the first information-processing device 1h.   The transmitted tunnel communication identifier "111222333" is accepted by ~~tunnel communication identifier acceptor~~the tunnel communication identifier

15   acceptor 17 of ~~first information-processing device 1~~the first information-processing device 1e (S703).   The tunnel communication identifier is passed to ~~address determination part 14~~the address determination part 14h.

20   Address determination part 14h, when receiving a determination from ~~judgement~~ the judgment part 16, and a tunnel communication identifier from ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 17, determines an IP address used for communication target data in tunnel communication, according to

25   the determination and tunnel communication identifier.   Specifically, ~~address determination part 14~~the address determination part 14h determines an address with either of the following two methods, for

example (S704).

[Method of Determining an Address Using a Table]

The address determined by ~~address determination part 14~~the address determination part 14h has the structure shown in Fig. 28A.

5   That is, the first eight bits show "169" and next eight bits, "254".   The first four bits of the further next 16 bits indicates a network address, which is a remainder after dividing a tunnel communication identifier by "16,384".   The last two bits show a host address, which is determined using the table of Fig. 28B.   The table of Fig. 28B shows

10   correspondence between information indicating a caller or callee and its IP address.   ~~First information-processing device 1~~The first information-processing device 1h has been judged as a caller by ~~judgement~~ judgment part 16, and thus ~~address determination part 14~~the address determination part 14h determines the host address of

15   ~~first information-processing device 1~~the first information-processing device 1h as "1", using the table of Fig. 28B.   Also, ~~second information-processing device 2~~the second information-processing device 2b is a callee, and thus ~~address determination part 14~~the address determination part 14h determines the host address of ~~second~~

20   ~~information-processing device 2~~the second information-processing device 2b as "2".   Fig. 28B shows correspondence of information showing a caller or callee to an IP address in a tabular form.   However, they may be made correspond with a means other than a tabular form.   Further, the remainder "7741", after dividing the tunnel

25   communication identifier "111222333" by "16,384", is a network address common to ~~first information-processing device 1~~the first information-processing device 1h and ~~second information-processing~~

~~device 2~~the second information-processing device 2b.   Therefore, ~~address determination part 14~~the address determination part 14h determines the IP address of ~~first information-processing device 1~~the first information-processing device 1h as "169.254.120.245".

5   ("01111000111101", which is binary notation for "7741", and "01", which is binary notation for "1", are divided into eight bits each, "01111000" and "11110101".   They are "120" and "245", respectively in decimal notation.)   In the same way, ~~address determination part 14~~the address determination part 14h determines the IP address of ~~second~~

10   ~~information-processing device 2~~the second information-processing device 2b as "169.254.120.246".   Then, ~~address determination part 14~~the address determination part 14h passes these addresses to ~~tunnel communication part 11~~the tunnel communication part 11 and ~~address transmitter 15~~the address transmitter 15.   Here, if the addresses are

15   determined in this way, "255.255.255.252" is used as a subnet mask in each information-processing device.   As in this way where the ~~an~~ address is determined using a table, ~~address determination part 14~~the address determination part 14h may determine a part of the ~~an~~ address, according to a communication destination device identifier and

20   communication source device identifier; and the other part of the address, according to a tunnel communication identifier.

        Here, ~~address determination part 14~~the address determination part 14h may determine a host address by selecting from a plurality of predetermined addresses.   One such example is that, when ~~address~~

25   ~~determination part 14~~the address determination part 14h has the table shown in Fig. 28C, and if the information-processing device is a caller, the host address may be selected from "1", "3", or "5", and if a callee,

from "2", "4", or "6".

[Method of Determining an Address Using a Function]

Address determination part 14h has the function "Func(argument 1, argument 2)" for determining an address. When calculating an address of a caller, "0" is substituted for argument 1; a callee, "1" is substituted for argument 1. For argument 2, tunnel communication identifier is substituted. In this concrete example, it is assumed that ~~address determination part 14~~the address determination part 14h substitutes "0" for argument 1; "111222333" for argument 2; and the function returns the value "192.168.0.1". This IP address is to be that of ~~first information-processing device 1~~the first information-processing device 1h. Meanwhile, it is assumed that ~~address determination part 14~~the address determination part 14h substitutes "1" for argument 1; "111222333" for argument 2; and the function returns the value "192.168.0.2". This IP address is to be that of ~~second information-processing device 2~~**the second information-processing device 2**b. Then, ~~address determination part 14~~the address determination part 14h passes these addresses to ~~tunnel communication part 11~~the tunnel communication part 11 and ~~address transmitter 15~~**the address transmitter 15**.

Here, the description is made for two different methods of determining an address. However, it is sufficient if ~~address determination part 14~~the address determination part 14h determines the ~~an~~ address according to a determination by ~~judgement~~ judgment part 16 and a tunnel communication identifier, and thus the ~~an~~ address may be determined with a method of determining an address other than these.

Address transmitter 15, in the same way as in the concrete example in embodiment 1, transmits the determined IP addresses of ~~first information-processing device 1~~the first information-processing device 1h and ~~second information-processing device 2~~the second

5   information-processing device 2b, to ~~second information-processing device 2~~the second information-processing device 2b (S705). Consequently, these IP addresses are accepted by ~~address acceptor 21~~the address acceptor 21 in ~~second information-processing device 2~~the second information-processing device 2b and passed to ~~tunnel~~

10   ~~communication part 22~~the tunnel communication part 22.   Further, ~~tunnel communication part 11~~the tunnel communication part 11, in the same way as in the concrete example in embodiment 1, performs tunnel communication using the determined address, and so does ~~tunnel~~ ~~communication part 22~~the tunnel communication part 22 using the

15   address accepted by ~~address acceptor 21~~the address acceptor 21.

As mentioned above, the communication system according to this embodiment can determine the ~~an~~ address used for communication target data in tunnel communication, according to a determination by ~~judgement~~ the judgment part 16 and ~~a~~ the tunnel communication

20   identifier for identifying tunnel communication, which is a deterministic algorithm, simpler than a heuristic one.   Consequently, this embodiment has the same advantage as embodiment 1.

In this embodiment, the description is made for a structure where ~~first information-processing device 1~~the first information-processing

25   device 1h has ~~address transmitter 15~~the address transmitter 15. However, ~~first information-processing device 1~~the first information-processing device 1h may have an address output part for

outputting an address determined by ~~address determination part 14~~the

address determination part 14h, instead of ~~address transmitter 15~~the

address transmitter 15.   Here, this output may be, for example,

display on a display device (e.g. CRT or liquid crystal display),

5   transmission to a given device via communication lines, printing by a

printer, recording on a given recording medium, or sound output by a

speaker.   The address output part may optionally include an output

device (e.g. display device or printer).   Also, the address output part

may be implemented with hardware, or software such as a driver for

10   driving such a device.   The address having been output may be set in

~~second information-processing device 2~~the second

information-processing device 2b, for example, by being recorded on a

given recording medium, or by being sent to the user of ~~second~~

~~information-processing device 2~~the second information-processing

15   device 2b via email, facsimile, or the like.

In this embodiment, the description is made for a case where a

tunnel communication identifier generated by ~~server 4~~the server 4e is

transmitted only to ~~first information-processing device 1~~the first

information-processing device 1h.   However, the tunnel

20   communication identifier may be transmitted to ~~second~~

~~information-processing device 2~~the second information-processing

device 2b as well as to ~~first information-processing device 1~~the first

information-processing device 1h.

(Embodiment 11)

25   A description is made for a communication system according to

embodiment 11 of the present invention, referring to the drawings.   In

the communication system according to this embodiment, each

information-processing device determines <u>the</u> ~~an~~ address used for communication target data in tunnel communication, according to a determination related to whether each information-processing device is a caller or callee, and to a tunnel communication identifier.

5   Fig. 29 shows the makeup of the communication system according to this embodiment.   The communication system according to this embodiment is equipped with ~~first information-processing device 1~~<u>the first information-processing device 1</u>i, ~~second information-processing device 2~~<u>the second information-processing device 2</u>i, and ~~server 4~~<u>the server 4</u>e, all connected one another via ~~communication line 3~~<u>the communication line 3</u>.   Server 4e is the same as that in embodiment 7, and thus its description is omitted.   However, in this embodiment, addresses are determined by ~~first information-processing device 1~~<u>the first information-processing device 1</u>i and ~~second information-processing device 2~~<u>the second information-processing device 2</u>i, and thus ~~server 4~~<u>the server 4</u>e is to transmit the generated tunnel communication identifier to ~~first information-processing device 1~~<u>the first information-processing device 1</u>i and ~~second information-processing device 2~~<u>the second information-processing device 2</u>i, respectively.

       ~~First information-processing device 1~~<u>The first information-processing device 1</u>i is equipped with ~~tunnel communication part 11~~<u>the tunnel communication part 11</u>, ~~address determination part 14~~<u>the address determination part 14</u>h, ~~judgement~~ <u>judgment</u> part 16, and ~~tunnel communication identifier acceptor~~<u>the tunnel communication identifier acceptor</u> 17.   Here, ~~tunnel communication part 11~~<u>the tunnel communication part 11</u>, ~~address~~

~~determination part 14~~<u>the address determination part 14</u>h, ~~judgement~~ <u>judgment</u> part 16, and ~~tunnel communication identifier acceptor~~<u>the tunnel communication identifier acceptor</u> 17 are the same as those in embodiment 10 , and thus their descriptions are omitted.

5   Second information-processing device 2i is equipped with ~~tunnel communication part 22~~<u>a tunnel communication part 22</u>, ~~address determination part 26~~<u>an address determination part 26</u>i, ~~judgement~~ <u>a judgment</u> part 27, and ~~tunnel communication identifier acceptor~~<u>a tunnel communication identifier acceptor</u> 28.   Here, ~~tunnel communication part 22~~<u>the tunnel communication part 22</u> is the same

10   as that in embodiment 4; ~~tunnel communication identifier acceptor~~<u>the tunnel communication identifier acceptor</u> 28, in embodiment 8; ~~address determination part 26~~<u>the address determination part 26</u>i, ~~address determination part 14~~<u>the address determination part 14</u>h in

15   embodiment 10, and thus their descriptions are omitted.

In addition, the action in which ~~first information-processing device 1~~<u>the first information-processing device 1</u>i determines an address is the same as that shown in Fig. 27 in embodiment 10, except that the process for transmitting an address at S705 is not performed, and thus

20   its description is omitted.   Further, the action in which ~~second information-processing device 2~~<u>the second information-processing device 2</u>i in this embodiment determines an address is the same as that shown in Fig. 27 in embodiment 10, except that ~~tunnel communication part 11~~<u>the tunnel communication part 11</u>, ~~address determination part 14~~<u>the address determination part 14</u>h, ~~judgement~~ <u>the judgment</u> part 16,

25   and ~~tunnel communication identifier acceptor~~<u>the tunnel communication identifier acceptor</u> 17 correspond to ~~tunnel~~

communication part 22~~the tunnel communication part 22~~, ~~address determination part 26~~the address determination part 26i, ~~judgement~~ judgment part 27, and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 28 at S705, respectively, and

5   that they do not transmit addresses, and thus their descriptions are omitted.

Next, a description is made for the action of the communication system according to this embodiment, using a concrete example.   Here, the action in which ~~first information-processing device 1~~the first

10   information-processing device 1i determines the ~~an~~ IP address is the same as that in the concrete example in embodiment 10, and thus its description is omitted.   From ~~server 4~~the server 4e, a tunnel communication identifier is assumed to be transmitted to ~~second information-processing device 2~~the second information-processing

15   device 2i as well as to ~~first information-processing device 1~~the first information-processing device 1i.

Server 4e, according to a request from ~~first information-processing device 1~~the first information-processing device 1i, transmits the ~~an~~ IP address of ~~second information-processing device 2~~the second

20   information-processing device 2i to ~~first information-processing device 1~~the first information-processing device 1i, and also information showing that ~~first information-processing device 1~~the first information-processing device 1i is requesting tunnel communication with ~~second information-processing device 2~~the second

25   information-processing device 2i, to ~~second information-processing device 2~~the second information-processing device 2i.   In addition, ~~server 4~~the server 4e generates the~~a~~ tunnel communication identifier

and transmits the tunnel communication identifier to ~~first information-processing device 1~~the first information-processing device 1i and ~~second information-processing device 2~~the second information-processing device 2i.

5   Tunnel communication part 22 of ~~second information-processing device 2~~the second information-processing device 2i, when receiving information transmitted from ~~server 4~~the server 4e, ~~judges~~ determines that tunnel communication is to be started (S701), and ~~judgement~~ the judgment part 27 ~~judges~~ determines that ~~second information-processing device 2~~the second information-processing device 2i is a callee (S702).   Tunnel communication identifier acceptor 28 accepts a tunnel communication identifier transmitted from ~~server 4~~the server 4e through ~~tunnel communication part 22~~the tunnel communication part 22 (S703).   Here, the process in which ~~address determination part 26~~the address determination part 26i determines the IP addresses of ~~first information-processing device 1~~the first information-processing device 1i and ~~second information-processing device 2~~the second information-processing device 2i, according to a determination by ~~judgement~~ the judgment part 27 and a tunnel

20   communication identifier is the same as that in embodiment 10, and thus its description is omitted.   Also, the actions in which tunnel communication is performed after this address determination are the same as those in the concrete example in embodiment 10, except that an address is not transmitted, and thus its description is omitted.

25   As mentioned above, in the communication system according to this embodiment, each information-processing device can also determine the ~~an~~ address used for communication target data in tunnel

communication, according to a determination whether the

information-processing device is a caller or callee, and to a tunnel

communication identifier.   Each information-processing device

determines its own address, thus dispensing with transmitting the ~~an~~

5   address, bringing the same effect as that in embodiment 2.

In this embodiment, the description is made for a case where the

addresses of a communication source and destination are determined

by each information-processing device.   However, when only the

address of ~~first information-processing device 1~~the first

10   information-processing device 1i is determined by itself, and when only

the address of ~~second information-processing device 2~~**the second**

information-processing device 2i is determined by itself, for example,

they may be passed to the other party's information-processing device

directly or indirectly.

15   (Embodiment 12)

A description is made for a communication system according to

embodiment 12 of the present invention, referring to drawings.   The

communication system according to this embodiment determines an

address used for communication target data in tunnel communication,

20   according to a determination related to whether the

information-processing device is a caller or callee, and to a tunnel

communication identifier.

Fig. 30 shows the makeup of the communication system according

to this embodiment.   The communication system according to this

25   embodiment is equipped with ~~first information-processing device 5~~the

first information-processing device 5, ~~second information-processing~~

~~device 6~~the second information-processing device 6, and ~~server 7~~the

server 7j, all connected one another via ~~communication line 3~~the communication line 3 . Here, ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6 are the same as those in embodiment 3, and thus their descriptions are omitted.

Server 7j, in the same way as ~~server 4~~the server 4 in embodiment 1, performs a process to establish tunnel communication performed between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, and also determines an address used in the tunnel communication, equipped with a communication control unit 71, an address determination part 73j, an address transmitter 74, ~~judgement~~ a judgment part 75, a tunnel communication identifier generation part 41, and ~~tunnel communication identifier acceptor~~a tunnel communication identifier acceptor 76. Here, the communication control unit 71 and the address transmitter 74 are the same as those in embodiment 3; ~~judgement~~ the judgment part 75, in embodiment 6; the tunnel communication identifier generation part 41 and ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 76, in embodiment 9, and thus their descriptions are omitted.

Address determination part 73j determines a first address of ~~first information-processing device 5~~the first information-processing device 5 and a second address of ~~second information-processing device 6~~the second information-processing device 6, both used for communication target data in tunnel communication encapsulated in tunnel

communication performed between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, according to a determination by ~~judgement~~ the judgment part

5   75 and a tunnel communication identifier accepted by ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 76.   The method of determining the ~~an~~ address is the same as that by ~~address determination part 14~~the address determination part 14h in embodiment 10, and thus its description is omitted.

10   Next, a description is made for the action of a communication system, in particular, the action for determining an address, according to this embodiment.   Fig. 31 is a flowchart showing the action for determining an address in ~~server 7~~the server 7j.

(S801) Communication control unit 71 ~~judges~~ determines whether

15   tunnel communication between ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6 is to be started.   If started, the flow goes to S802; otherwise, repeats process S801 until tunnel communication is started.

20   (S802) ~~judgement~~ judgment part 75 ~~judges~~ determines whether ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6 are a caller or callee, respectively.

(S803) Tunnel communication identifier generation part 41

25   generates ~~the~~a tunnel communication identifier and passes the generated tunnel communication identifier to ~~tunnel communication identifier acceptor~~the tunnel communication identifier acceptor 76.

(S804) Tunnel communication identifier acceptor 76 accepts ~~the~~a tunnel communication identifier passed from the tunnel communication identifier generation part 41.

(S805) Address determination part 73j determines the ~~an~~ address

5   according to a tunnel communication identifier accepted by ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 76 and a determination by ~~judgement~~ judgment part 75. This method of determining the ~~an~~ address is the same as that in the concrete example in embodiment 10, and thus its description is

10   omitted.

(S806) Address transmitter 74 transmits the addresses of ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, both determined by the address

15   determination part 73j, to ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, and then the flow returns to S801.

Here, in the flowchart of Fig. 31, the process ends with an

20   interruption of power off or process end.

Next, a description is made for the action of the communication system according to this embodiment, using a concrete example.   First, the data structure in tunnel communication is the same as that in Fig. 5.   In addition, the IP addresses and device identifiers of

25   information-processing devices and a server are assumed to be the same as those in the concrete example in embodiment 3.   Further, the processes in which ~~first information-processing device 5~~the first

information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6 respectively register IP addresses and device identifying information to ~~server 7~~the server 7j are the same as those in embodiment 3, and thus their descriptions are omitted.

Next, ~~tunnel communication part 52~~the tunnel communication part 52 of ~~first information-processing device 5~~the first information-processing device 5 transmits a second device identifier for identifying ~~second information-processing device 6~~the second information-processing device 6 and a request for tunnel communication with ~~second information-processing device 6~~the second information-processing device 6, to ~~server 7~~the server 7j.   Then, they are received by the communication control unit 71.   Communication control unit 71 ~~judges~~ determines that tunnel communication is to be started (S801), acquires the ~~an~~ IP address of ~~first information-processing device 5~~the first information-processing device 5 from the header of a packet transmitted from ~~first information-processing device 5~~the first information-processing device 5, refers to the address identifier correspondence information shown in Fig. 11, and acquires the device identifier "12345678" of ~~first information-processing device 5~~the first information-processing device 5.

Communication control unit 71 further acquires the IP address "131.206.10.240" corresponding to the device identifier "98765432" transmitted from ~~first information-processing device 5~~the first information-processing device 5, referring to the address identifier correspondence information shown in Fig. 11.   Then, the

communication control unit 71 transmits the IP address of ~~second information-processing device 6~~the second information-processing device 6 to ~~first information-processing device 5~~the first information-processing device 5.

5   ~~judgement~~ the judgment part 75, because the communication control unit 71 has received information transmitted from ~~first information-processing device 5~~the first information-processing device 5, requesting tunnel communication with ~~second information-processing device 6~~the second information-processing

10   device 6, ~~judges~~ determines that ~~first information-processing device 5~~the first information-processing device 5 is a caller and ~~second information-processing device 6~~the second information-processing device 6 is a callee (S802). ~~Judgement~~ Judgment part 75 then passes to the address determination part 73j, information showing that the

15   information-processing device identified by the device identifier "12345678" is a caller, and "98765432" is a callee.

Tunnel communication identifier generation part 41, corresponding to the ~~a~~ fact that the communication control unit 71 has received information showing that the tunnel communication is to be

20   started, generates a new tunnel communication identifier "111222333" and passes the generated tunnel communication identifier to ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 76 (S803). Consequently, the tunnel communication identifier is accepted by ~~tunnel communication identifier acceptor~~**the**

25   **tunnel communication identifier acceptor** 76 (S804).

After that, the address determination part 73j determines IP addresses to be used by ~~first information-processing device 5~~the first

information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, according to the tunnel communication identifier accepted by ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 76,

5   and to a determination received from ~~judgement~~ the judgment part 75, and passes the determined address, making it correspond to the device identifier, to address transmitter 74 (S805).   This method of determining an address is the same as that in the concrete example in embodiment 10, and thus its description is omitted.

10   Address transmitter 74, when receiving a set of the IP address of ~~first information-processing device 5~~the first information-processing device 5 determined by address determination part 73j and the device identifier of ~~first information-processing device 5~~the first information-processing device 5, and a set of the IP address of ~~second~~

15   ~~information-processing device 6~~the second information-processing device 6 and the device identifier of the ~~second information-processing device 6~~the second information-processing device 6, refers to the address identifier correspondence information retained by communication control unit 71 to acquire IP addresses of

20   information-processing devices corresponding to the respective device identifiers.   Then, the address transmitter 74 transmits the two sets of the device identifiers and IP addresses to ~~first information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second

25   information-processing device 6 (S806).   The processes hereafter are the same as those in the concrete example in embodiment 3, and thus their descriptions are omitted.

As mentioned above, in the communication system according to this embodiment, ~~server 7~~the server 7j can determine an address used for communication target data in tunnel communication performed between ~~first information-processing device 5~~the first

5   information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6, according to a determination related to whether the information-processing device is a caller or callee, and to a tunnel communication identifier.   This enables an address to be easily determined with a simple deterministic

10   algorithm.

In this embodiment, the description is made for a case where the address transmitter 74 transmits an address determined by the address determination part 73j.   However, an address output part for outputting an address determined by address determination part 73j

15   may be equipped instead of the address transmitter 74.   Here, this output may be, for example, display on a display device (e.g. CRT or liquid crystal display), transmission to a given device via communication lines, printing by a printer, recording on a given recording medium, or sound output by a speaker.   The address output

20   part may optionally include an output device (e.g. display device or printer).   Also, the address output part may be implemented with hardware, or software such as a driver for driving such a device.   The address having been output may be set in ~~first information-processing device 5~~the first information-processing device 5 or ~~second~~

25   ~~information-processing device 6~~the second information-processing device 6, for example, by being recorded on a given recording medium, or alternatively by being sent to the user of ~~second~~

~~information-processing device 6~~the second information-processing device 6 by the administrator of ~~server 7~~the server 7j via email, facsimile, or others.

Further, in this embodiment, the description is made for a case

5   where the address transmitter 74 of ~~server 7~~the server 7j transmits two addresses determined by address determination part 73j to ~~second information-processing device 6~~the second information-processing device 6.   However, address transmitter 74 may transmit only the address of ~~second information-processing device 6~~the second

10   information-processing device 6 to ~~second information-processing device 6~~the second information-processing device 6.   In this case, ~~second information-processing device 2~~**the second information-processing device 2**j can acquire an address of ~~first information-processing device 5~~the first information-processing device

15   5 from the header of encapsulated communication target data transmitted from ~~first information-processing device 5~~the first information-processing device 5.

In this embodiment, the description is made for a case where ~~server 7~~the server 7j transmits both the addresses of ~~first~~

20   ~~information-processing device 5~~the first information-processing device 5 and ~~second information-processing device 6~~the second information-processing device 6.   However, ~~server 7~~the server 7j may first transmit the address of ~~first information-processing device 5~~the first information-processing device 5 to ~~first information-processing~~

25   ~~device 5~~the first information-processing device 5, and that of ~~second information-processing device 6~~the second information-processing device 6 to ~~second information-processing device 6~~the second

information-processing device 6, and then transmit the address of the other party, when an inquiry related to the address of the other party in tunnel communication is made from an information-processing device.

5   In embodiments 9 and 12, the description is made for a case where ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 76 accepts a tunnel communication identifier generated by the tunnel communication identifier generation part 41. However, as aforementioned, ~~tunnel communication identifier acceptor~~**the tunnel communication identifier acceptor** 76 may accept a

10   tunnel communication identifier having been input by an input device, or a tunnel communication identifier read from a recording medium, for example.

(Embodiment 13)

15   A description is made for a communication system according to embodiment 13 of the present invention, referring to drawings. The communication system according to this embodiment, when detecting that two or more addresses used for communication target data in tunnel communication are the same ~~agree~~, changes such addresses.

20   Fig. 32 shows the makeup of the communication system according to this embodiment. The communication system according to this embodiment is equipped with ~~first information-processing device 1~~a first information-processing device 1k, ~~second information-processing device 2~~a second information-processing device 2b, a third

25   information-processing device 3k, and ~~server 4~~a server 4, all connected one another via ~~communication line 3~~the communication line 3. Here, ~~second information-processing device 2~~the second

information-processing device 2b is the same as that in embodiment 4; ~~server 4~~the server 4, in embodiment 1, and thus their descriptions are omitted.

~~First information-processing device 1~~The first

5   information-processing device 1k according to this embodiment is assumed to perform tunnel communication with two or more information-processing devices.   In other words, ~~first information-processing device 1~~the first information-processing device 1k is assumed to perform tunnel communication with ~~second~~

10   ~~information-processing device 2~~the second information-processing device 2b and the third information-processing device 3k.   In such a case, if an address used for communication target data in tunnel communication between ~~first information-processing device 1~~the first information-processing device 1k and ~~second information-processing~~

15   ~~device 2~~the second information-processing device 2b is "192.168.0.1", and if that between ~~first information-processing device 1~~the first information-processing device 1k and the third information-processing device 3k is "192.168.0.1", for example, the address with which ~~first information-processing device 1~~the first information-processing device

20   1k uses in tunnel communication with ~~second information-processing device 2~~the second information-processing device 2b, and the third information-processing device 3k results in agreement.   In tunnel communication, like communication using a virtual network interface, if addresses to be used are the same ~~agree~~, addresses allocated to the

25   virtual network interface are also the same. ~~result in agreement~~. (Communication is performed using two NICs with an identical addresses, for example.)   Consequently, ~~first information-processing~~

~~device 1~~the first information-processing device 1k is unable to perform

communication.   In such a case, ~~first information-processing device 1~~the first information-processing device 1k according to this

embodiment changes at least one address to enable itself to

5   simultaneously perform two or more tunnel communications.

Fig. 33 is a block diagram showing the makeup of ~~first information-processing device 1~~the first information-processing device 1k according to this embodiment.   ~~First information-processing device 1~~The first information-processing device 1k according to this

10   embodiment is equipped with ~~tunnel communication part 11~~the tunnel communication part 11, ~~address determination part 14~~the address determination part 14b, ~~address transmitter 15~~the address transmitter 15, ~~judgement~~ the judgment part 16, detection part 18, and address changing part 19.   Here, ~~tunnel communication part 11~~the tunnel

15   communication part 11, ~~address determination part 14~~the address determination part 14b, ~~address transmitter 15~~the address transmitter 15, and ~~judgement~~ the judgment part 16 are the same as those in embodiment 4, except that ~~tunnel communication part 11~~the tunnel communication part 11 performs tunnel communication with two or

20   more devices for communication destination, and that ~~address transmitter 15~~the address transmitter 15 transmits a changed address as well, and thus their descriptions are omitted.

Detection part 18 detects in two or more tunnel communications that two or more addresses used for communication target data are the

25   same. ~~agree~~.   For example, detection is performed for comparision ~~agreement~~ of the address of ~~first information-processing device 1~~the first information-processing device 1k[[,]] that ~~tunnel communication~~

~~part 11~~<u>the tunnel communication part 11</u> uses for communication target data in tunnel communication with ~~second information-processing device 2~~<u>**the second information-processing device 2**</u>b, and that with <u>the</u> third information-processing device 3k<u>.</u>

5   Address changing part 19, when detection part 18 detects two or more addresses <u>are the same</u> ~~agree~~, changes an address used for communication target data.   Here, in this address change, only the address of ~~first information-processing device 1~~<u>the first information-processing device 1</u>k may be changed, or both the

10   addresses of ~~first information-processing device 1~~<u>the first information-processing device 1</u>k and of an information-processing device as a communication destination for ~~first information-processing device 1~~<u>the first information-processing device 1</u>k may be changed, for example, out of the addresses used for communication target data in

15   tunnel communication.   Address changing part 19 may change some addresses out of two or more addresses that <u>are the same</u> ~~agree~~, so detected by <u>the</u> detection part 18, so that these addresses <u>are not the same</u> ~~do not agree~~ (If two addresses agree, for example, only one address may be changed.), or   all the addresses may be changed. (If

20   two addresses <u>are the same,</u> ~~agree~~, for example, both addresses may be changed.)   A concrete method of changing an address is described hereinafter.

Fig. 34 is a block diagram showing the makeup of ~~third information-processing device 3~~<u>**the third information-processing device**</u>

25   <u>**3**</u>k according to this embodiment.   Third information-processing device 3k according to this embodiment is equipped with <u>an</u> address acceptor 31 and <u>a</u> tunnel communication part 32.   Address acceptor 31

and tunnel communication part 32 are the same as ~~address acceptor 21~~**the address acceptor 21** and ~~tunnel communication part 22~~**the tunnel communication part 22** in ~~second information-processing device 2~~**the second information-processing device 2**b according to embodiment 4,

5   respectively, and thus their descriptions are omitted.

Next, a description is made for the action of a communication system, in particular, the action for determining and changing an address, according to this embodiment.   Fig. 35 is a flowchart showing the action for determining an address in ~~first information-processing~~

10   ~~device 1~~**the first information-processing device 1**k.   Here, in the flowchart of Fig. 35, processes S301 through S304 are the same as those in the flowchart of Fig. 14, and thus their descriptions are omitted.

(S901) Detection part 18 ~~judges~~ **determines** whether two or more

15   addresses used for communication target data **are the same** ~~agree~~ in two or more tunnel communications performed by ~~tunnel communication part 11~~**the tunnel communication part 11**.   If detected as agreeing, the flow goes to S902; otherwise, returns to S301.

(S902) Address changing part 19 changes an address used for

20   communication target data.

(S903) Address transmitter 15 transmits an address changed by **the** address changing part 19.   The destination to which this address is transmitted is an information-processing device that performs communication related to the address changed by ~~address changing~~

25   ~~part 19~~**the address changing part 19**.   If an address used for communication target data in tunnel communication with ~~second information-processing device 2~~**the second information-processing**

device 2b has been changed, for example, the changed address is transmitted to ~~second information-processing device 2~~**the second information-processing device 2**b.   If an address used for communication target data in tunnel communication with ~~third information-processing device 3~~**the third information-processing device 3**k has been changed, the changed address is transmitted to ~~third information-processing device 3~~**the third information-processing device 3**k.   Then, the flow returns to S301.

Here, in the flowchart of Fig. 35, the process ends with an interruption of power off or process end.   In addition, the flowchart of Fig. 35 shows a case where the processes related to address determination (S301 through S304) and those related to address change (S901 through S903) are performed separately.   However, the following process may be performed.   That is, ~~judgement is made~~ **determines** whether the addresses **are the same** ~~agree~~ immediately after the addresses are determined.   If the addresses **are not the same** ~~do not agree~~, the address transmission process is performed; otherwise, the changed addresses are transmitted.

Next, a description is made for the action of the communication system according to this embodiment, using a concrete example.   First, the data structure in tunnel communication is the same as that in Fig. 5.   In addition, the IP addresses and device identifiers of information-processing devices and a server, are the same as those in the concrete example in embodiment 3.   Further, the processes in which ~~first information-processing device 1~~**the first information-processing device 1**k, ~~second information-processing device 2~~**the second information-processing device 2**b, and ~~third~~

~~information-processing device 3~~the third information-processing device

3k respectively register IP addresses and device identifying

information to a server are the same as those in embodiment 3, and

thus their descriptions are omitted.   The process in which tunnel

5   communication is started between ~~first information-processing device~~

~~1~~the first information-processing device 1k and ~~second~~

~~information-processing device 2~~the second information-processing

device 2b is the same as that in embodiment 4, and thus its description

is omitted.   Also, the process in which tunnel communication is

10   started between ~~first information-processing device 1~~the first

information-processing device 1k and ~~third information-processing~~

~~device 3~~the third information-processing device 3k is the same as that

in embodiment 4, and thus its description is omitted.   Here, it is

assumed that the process for starting tunnel communication between

15   ~~first information-processing device 1~~the first information-processing

device 1k and ~~third information-processing device 3~~the third

information-processing device 3k is executed, and in the tunnel

communication, the IP address "192.168.0.1" of ~~first~~

~~information-processing device 1~~the first information-processing device

20   1k, used for communication target data, has agreed with the IP address

"192.168.0.1" of ~~first information-processing device 1~~the first

information-processing device 1k, used for communication target data

in tunnel communication with ~~second information-processing device~~

~~2~~the second information-processing device 2b.

25   Consequently, the detection part 18 ~~judges~~ determines that both

addresses are the same ~~agree~~ (S901), and ~~address changing part 19~~the

address changing part 19 changes an address used for communication

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target data in tunnel communication performed between ~~first information-processing device 1~~the first information-processing device 1k and ~~third information-processing device 3~~the third information-processing device 3k.   Specifically, ~~address changing part 19~~the address changing part 19 changes an address with one of the following three methods, for example (S902).   Here, the address is assumed to be "192.168.0.2" of ~~third information-processing device 3~~the third information-processing device 3k used for communication target data in tunnel communication performed between ~~first information-processing device 1~~the first information-processing device 1k and ~~third information-processing device 3~~the third information-processing device 3k.   Further, in this address, the last eight bits are assumed to represent a host address.   (That is, the subnet mask is "255.255.255.0".)

[Method of Changing a Host Address]

Address changing part 19 adds "1" to the host address of the IP address "192.168.0.1" of ~~first information-processing device 1~~the first information-processing device 1k to determine the IP address of ~~first information-processing device 1~~the first information-processing device 1k as "192.168.0.2".   Address changing part 19 also adds "1" to the host address of the IP address "192.168.0.2" of ~~third information-processing device 3~~the third information-processing device 3k to determine the IP address of ~~third information-processing device 3~~the third information-processing device 3k as "192.168.0.3".

[Method of Changing a Network Address]

Address changing part 19 adds "1" to the network address of the IP address "192.168.0.1" of ~~first information-processing device 1~~the first

information-processing device 1k to determine the IP address of ~~first information-processing device 1~~the first information-processing device 1k as "192.168.1.1".   Address changing part 19 also adds "1" to the network address of the IP address "192.168.0.2 of ~~third information-processing device 3~~**the third information-processing device 3**k to determine the IP address of ~~third information-processing device 3~~**the third information-processing device 3**k as "192.168.1.2".

[Method of Changing a Host Address and Network Address]

Address changing part 19 adds "1" to the network address of IP address "192.168.0.1" of ~~first information-processing device 1~~the first information-processing device 1k and to the host address to determine the IP address of ~~first information-processing device 1~~the first information-processing device 1k as "192.168.1.2".   Address changing part 19 also adds "1" to the network address of the IP address "192.168.0.2" of ~~third information-processing device 3~~**the third information-processing device 3**k and to the host address to determine the IP address of ~~third information-processing device 3~~**the third information-processing device 3**k as "192.168.1.3".

Here, the description is made for three different methods of determining an address.   However, it is sufficient if ~~address changing part 19~~**the address changing part 19** changes an address so as to resolve address agreement, and thus an address may be changed with an address change method other than these.   For example, in this concrete example, only the IP address of ~~first information-processing device 1~~the first information-processing device 1k may be changed as long as it is possible that the IP addresses of ~~first information-processing device 1~~the first information-processing device

1k and ~~third information-processing device 3~~the third information-processing device 3k are not the same ~~to agree~~.

In addition, if it is possible that a changed address is determined so as to be different from an address used for communication target data in tunnel communication with another information-processing device, the address may be determined again as a different one. In this case, if only the address of one information-processing device in tunnel communication is changed, it is required not to overlap with that of the other information-processing device in tunnel communication.

Address transmitter 15, in the same way as in the concrete example in embodiment 1, transmits the changed IP address of ~~first information-processing device 1~~the first information-processing device 1k and the IP address of ~~third information-processing device 3~~the third information-processing device 3k, to ~~third information-processing device 3~~the third information-processing device 3k (S903). Consequently, these IP addresses are accepted by address acceptor 31 in ~~third information-processing device 3~~the third information-processing device 3k and passed to tunnel communication part 32. Further, ~~tunnel communication part 11~~the tunnel communication part 11 performs tunnel communication using the changed address, and tunnel communication part 32 performs tunnel communication using the changed address accepted by address acceptor 31.

As mentioned above, in the communication system according to this embodiment, even if addresses used for communication target data in tunnel communication are the same ~~agree,~~ they can be changed.

Consequently, a situation can be avoided where two or more tunnel communications are disabled, enabling two or more tunnel communications to be performed appropriately.

Here, in this embodiment, namely a communication system according to embodiment 4, the description is made for a case where a first information-processing device is equipped with ~~detection part 18~~the detection part 18 and ~~address changing part 19~~the address changing part 19.   However, also in a communication system other than that in embodiment 4, an information-processing device may be equipped with a detection part and an address changing part.   For example, in a communication system according to embodiments 7 and 10, when a first information-processing device performs tunnel communication with two or more devices where the first information-processing device is equipped with a detection part and an address changing part, if addresses used for communication target data are the same ~~agree~~, tunnel communication with two or more devices may be appropriately performed by changing at least one of the addresses.

(Embodiment 14)

A description is made for a communication system according to embodiment 14 of the present invention, referring to drawings.   The communication system according to this embodiment changes an address in respective information-processing devices.

The communication system according to this embodiment is assumed to be the same as that in Fig. 32.   However, ~~first information-processing device 1~~the first information-processing device 1k is assumed to correspond to ~~first information-processing device 1~~the

first information-processing device 1m; ~~second information-processing device 2~~the second information-processing device 2b, to ~~second information-processing device 2~~**the second information-processing device 2**m.

5   Fig. 36 is a block diagram showing the makeup of ~~first information-processing device 1~~a first information-processing device 1m according to this embodiment. ~~First information-processing device 1~~The first information-processing device 1m according to this embodiment is equipped with ~~tunnel communication part 11~~the tunnel

10   communication part 11, ~~address determination part 14~~the address determination part 14b, ~~judgement~~ the judgment part 16, ~~detection part 18~~**the detection part 18**, ~~address changing part 19~~the address changing part 19, and the address change information transmitter 20. Here, ~~tunnel communication part 11~~the tunnel communication part 11,

15   ~~address determination part 14~~the address determination part 14b, ~~judgement~~ and the judgment part 16 are the same as those in embodiment 4; ~~detection part 18~~the detection part 18 and ~~address changing part 19~~**the address changing part 19 are the same as**, in embodiment 13, and thus their descriptions are omitted.

20   Address change information transmitter 20, when ~~detection part 18~~**the detection part 18** detects two or more addresses are the same, ~~agree~~, transmits address change information. Here, the address change information refers to one related to change of an address used for communication target data in tunnel communication. Address

25   change information may be one for only a direction to change an address, or one including a direction related to how to change an address. Address change information is transmitted to an

information-processing device for communication destination
performing tunnel communication for changing an address used for
communication target data.   Here, address change information
transmitter 20 may optionally include a transmission device for
5   transmitting (e.g. modem or network card).   In this case, a
transmission device (not illustrated) is to exist between the address
change information transmitter 20 and ~~communication line 3~~the
communication line 3.   Also, the address change information
transmitter 20 may be implemented by means of hardware, or software
10   such as a driver for driving the transmission device.

Fig. 37 is a block diagram showing the makeup of ~~second~~
~~information-processing device 2~~**the second information-processing**
device 2m according to this embodiment.   Second
information-processing device 2m according to this embodiment is
15   equipped with ~~tunnel communication part 22~~**the tunnel communication**
part 22, ~~address determination part 26~~the address determination part
26c, ~~judgement~~ judgment part 27, the address change information
receiver 29, and address changing part 30.   Here, ~~tunnel~~
~~communication part 22~~**the tunnel communication part 22**, ~~address~~
20   ~~determination part 26~~the address determination part 26c, ~~judgement~~
and the judgment part 27 are the same as those in embodiment 5, and
thus their descriptions are omitted.

Address change information receiver 29 receives address change
information.   Here, the address change information receiver 29 may
25   optionally include a receiving device for receiving (e.g. modem or
network card).   In this case, a receiving device (not illustrated) is to
exist between address change information receiver 29 and

communication line 3the communication line 3.   Also, address change

information receiver 29 may be implemented by means of hardware, or

software such as a driver for driving the receiving device.

Address changing part 30, when the address change information

5   receiver 29 receives address change information, changes the an

address used for communication target data in tunnel communication.

This process in which the address changing part 30 changes the an

address is the same as that by address changing part 19the address

changing part 19 according to embodiment 13, and thus its description

10   is omitted.

Next, a description is made for the action of a communication

system, in particular, the action for determining and changing an

address, according to this embodiment.   Fig. 38 is a flowchart showing

the action for determining and changing an address by first

15   information-processing device 1the first information-processing device

1m.   Here, in Fig. 38, the processes other than that of S1001 is the

same as those in the flowchart of Fig. 35 in embodiment 13, and thus

their descriptions are omitted.

(S1001) Address change information transmitter 20 transmits

20   address change information.   The transmission destination of this

address change information is an information-processing device for

communication destination performing tunnel communication for

changing an address used for communication target data.   Here, in

the flowchart of Fig. 38, the process ends with an interruption of power

25   off or process end.

Fig. 39 is a flowchart showing the action for determining and

changing an address by second information-processing device 2the

second information-processing device 2m.   Here, in Fig. 39, the

processes other than S1101 and S1102 are the same as those in the

flowchart of Fig. 35 in embodiment 13, except that ~~tunnel communication part 11~~the tunnel communication part 11 is ~~tunnel~~

5   ~~communication part 22~~**the tunnel communication part 22**; ~~address determination part 14~~the address determination part 14b, ~~address determination part 26~~the address determination part 26c; ~~judgement~~ judgment part 16, ~~judgement~~ judgment part 27, and thus their

descriptions are omitted.

10   (S1101) Address change information receiver 29 ~~judges~~ determines

whether address change information has been received.   If accepted,

the flow goes to S1102; otherwise, returns to S301.

         (S1102) Address changing part 30 changes the ~~an~~ address used for

communication target data in tunnel communication.   After that,

15   ~~tunnel communication part 22~~**the tunnel communication part 22** is to

perform tunnel communication using the changed address.   Then the

flow returns to S301.

         Here, in the flowchart of Fig. 39, the process ends with an

interruption of power off or process end.

20   Next, a description is made for the action of the communication

system according to this embodiment, using a concrete example.   First,

the data structure in tunnel communication is the same as that in Fig.

5.   In addition, the IP address and device identifiers of the

information-processing devices and a server are assumed to be the

25   same as those in the concrete example in embodiment 13.   First, the

process in which ~~first information-processing device 1~~the first

information-processing device 1m and ~~third information-processing~~

~~device 3~~<u>the third information-processing device 3</u>k start tunnel communication, and after that, ~~first information-processing device 1~~<u>the first information-processing device 1</u>m and ~~second information-processing device 2~~<u>the second information-processing</u>

5   <u>device 2</u>m start tunnel communication, is the same as that in embodiment 5, and thus its description is omitted.

It is assumed that, after ~~first information-processing device 1~~<u>the first information-processing device 1</u>m and ~~second information-processing device 2~~<u>the second information-processing</u>

10   <u>device 2</u>m start tunnel communication, the IP address of ~~first information-processing device 1~~<u>the first information-processing device 1</u>m, that ~~first information-processing device 1~~<u>the first information-processing device 1</u>m uses for communication target data in tunnel communication with ~~third information-processing device 3~~<u>the</u>

15   <u>third information-processing device 3</u>k, and the IP address of ~~first information-processing device 1~~<u>the first information-processing device 1</u>m, that ~~first information-processing device 1~~<u>the first information-processing device 1</u>m uses for communication target data in tunnel communication with ~~second information-processing device 2~~

20   <u>the second information-processing device 2</u>m, are both "192.168.0.1", and the agreement is detected by ~~detection part 18~~<u>the detection part 18</u> (S901). Consequently, address change information transmitter 20 transmits the address change information to ~~second information-processing device 2~~<u>the second information-processing</u>

25   <u>device 2</u>m (S1001). Further, ~~address changing part 19~~<u>the address changing part 19</u> of ~~first information-processing device 1~~<u>the first information-processing device 1</u>m, in the same way as in embodiment

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13, changes the IP address used for communication target data in tunnel communication with ~~second information-processing device 2~~the second information-processing device 2m (S902).

Address change information receiver 29 of ~~second information-processing device 2~~the second information-processing device 2m accepts address change information transmitted from ~~first information-processing device 1~~the first information-processing device 1m through ~~tunnel communication part 22~~the tunnel communication part 22 (S1101).   Then, the address changing part 30 changes the IP address that ~~second information-processing device 2~~the second information-processing device 2m uses for communication target data in tunnel communication with ~~first information-processing device 1~~the first information-processing device 1m (S1102).   This address change in address changing part 30 is to be made in the same way as in ~~address changing part 19~~the address changing part 19 in ~~first information-processing device 1~~the first information-processing device 1m.   Therefore, even if addresses are changed separately in ~~first information-processing device 1~~the first information-processing device 1m and ~~second information-processing device 2~~the second information-processing device 2m, the changed addresses are assumed to be the same in ~~first information-processing device 1~~the first information-processing device 1m and ~~second information-processing device 2~~the second information-processing device 2m.

Here, address change information may include information showing how the addresses are to be changed.   For example, when ~~first information-processing device 1~~the first information-processing device 1m performs address change where "1" is added to the host

address of ~~first information-processing device 1~~the first
information-processing device 1m and ~~second information-processing
device 2~~the second information-processing device 2m, if the address
change information transmitter 20 transmits address change

5   information including information showing the address change to
~~second information-processing device 2~~the second
information-processing device 2m, ~~second information-processing
device 2~~the second information-processing device 2m can perform
address change where "1" is added to the host address of ~~first
10   information-processing device 1~~the first information-processing device
1m and ~~second information-processing device 2~~the second
information-processing device 2m.   Consequently, even if ~~first
information-processing device 1~~the first information-processing device
1m and ~~second information-processing device 2~~the second
15   information-processing device 2m separately change addresses, the
changed addresses are identical.

As mentioned above, In the communication system according to
this embodiment, when ~~first information-processing device 1~~the first
information-processing device 1m detects that two or more addresses
20   are the same, ~~agree,~~ ~~second information-processing device 2~~the second
information-processing device 2m, as a result that the address is
changed and also address change information is transmitted to ~~second
information-processing device 2~~the second information-processing
device 2m at the communication destination, can change an address in
25   the same way as performed in ~~first information-processing device 1~~the
first information-processing device 1m.   Consequently, ~~first
information-processing device 1~~the first information-processing device

1m and ~~second information-processing device 2~~**the second information-processing device 2**m can perform tunnel communication using the changed addresses, and also resolve the address agreement that has occurred in ~~first information-processing device 1~~**the first**

5   **information-processing device 1**m.

Here, in this embodiment, namely a communication system according to embodiment 5, the description is made for a case where a first information-processing device is equipped with ~~detection part 18~~**the detection part 18** and others, and a second

10   information-processing device is equipped with **the** address change information receiver 29 and others.   However, in a communication system other than that in embodiment 5, first information-processing device and others may be also equipped with ~~detection part 18~~**the detection part 18** and others.   In a communication system according to

15   embodiments 8 and 11, for example, as a result that first information-processing device and second information-processing device are equipped with a detection part and an address changing part, when first information-processing device performs tunnel communication with two or more devices, tunnel communication with

20   two or more devices may be appropriately performed by changing at least one of the addresses if an address used for communication target data agrees.

(Embodiment 15)

A description is made for a communication system according to

25   embodiment 15 of the present invention, referring to drawings.   In the communication system according to this embodiment, a server, when detecting that two or more addresses used for communication target

data in tunnel communication <u>are the same,</u> ~~agree~~, changes the address.

The communication system according to this embodiment is assumed to be the same as that in Fig. 32. However, ~~first information-processing device 1~~<u>the first information-processing device 1</u>k is assumed to correspond to ~~first information-processing device 1~~<u>a first information-processing device 1</u>n; ~~second information-processing device 2~~**the second information-processing device 2**b, to ~~second information-processing device 2~~**a second information-processing device 2**n; ~~server 4~~<u>the server 4</u>, to ~~server 7~~<u>a server 7</u>n. Here, ~~third information-processing device 3~~**a third information-processing device 3**k is assumed to be the same as in embodiment 13.

Fig. 40 is a block diagram showing the makeup of ~~first information-processing device 1~~<u>the first information-processing device 1</u>n according to this embodiment. ~~First information-processing device 1~~<u>The first information-processing device 1</u>n according to this embodiment is equipped with ~~address acceptor 51~~<u>the address acceptor 51</u>, ~~tunnel communication part 52~~<u>the tunnel communication part 52</u>, <u>the </u>detection part 5, <u>an </u>address agreement information transmitter 54, <u>an </u>address change information receiver 55, and <u>an </u>address changing part 56. Here, ~~address acceptor 51~~<u>the address acceptor 51</u> and ~~tunnel communication part 52~~<u>the tunnel communication part 52</u> are the same as those in embodiment 3, except that ~~tunnel communication part 52~~<u>the tunnel communication part 52</u> performs tunnel communication with two or more devices for communication destination, and detection part 53 is the same as ~~detection part 18~~**the detection part 18** in embodiment 13, and thus their descriptions are omitted.

Address agreement information transmitter 54, when the detection part 53 detects two or more addresses are the same, ~~agree~~, transmits address agreement information to ~~server 7~~the server 7n. Here, address agreement information refers to information showing

5   that addresses used for communication target data in tunnel communication are the same ~~agree~~.   This address agreement information may include information showing in which tunnel communication the address used for communication target data has agreed with the address used for communication target data in other

10   tunnel communication, for example.   Here, the address agreement information transmitter 54 may optionally include a transmission device for transmitting (e.g. modem or network card).   In this case, a transmission device (not illustrated) is to exist between the address agreement information transmitter 54 and ~~communication line 3~~the

15   communication line 3.   Also, the address agreement information transmitter 54 may be implemented by means of hardware, or software such as a driver for driving the transmission device.

Address change information receiver 55 receives the address change information.   Here, the address change information refers to

20   information related to address change.   Address change information, as described in embodiment 13, for example, may be one for only a direction to change an address, one including a direction related to how to change an address (e.g. adding "1" to a host address), or one showing a changed address.   Here, the address change information receiver 55

25   may optionally include a receiving device for receiving (e.g. modem or network card).   In this case, a receiving device (not illustrated) is to exist between the address change information receiver 55 and

~~communication line 3~~the communication line 3.   Also, the address

change information receiver 55 may be implemented by means of

hardware, or software such as a driver for driving the receiving device.

Address changing part 56 changes an address used for

5   communication target data.   This address change is performed

according to address change information received by an address change

information receiver.   If address change information is information

showing how an address is changed, for example, the address changing

part 56 changes an address used for communication target data in

10   tunnel communication according to the address change information.

Fig. 41 is a block diagram showing the makeup of ~~second~~

~~information-processing device 2~~the second information-processing

device 2n according to this embodiment.   A s~~S~~econd

information-processing device 2n according to this embodiment is

15   equipped with an address acceptor 61, a tunnel communication part 62,

an address change information receiver 63, and an address changing

part 64.   Here, the address acceptor 61 and the tunnel communication

part 62 are the same as those in embodiment 3, and thus their

descriptions are omitted.   Also, the address change information

20   receiver 63 and the address changing part 64 are the same as the

address change information receiver 55 and the address changing part

56 above-mentioned, respectively, and thus their descriptions are

omitted.

Fig. 42 is a block diagram showing the makeup of ~~server 7~~a server

25   7n according to this embodiment.   Server 7n according to this

embodiment is equipped with a communication control unit 71, an

address determination part 73d, an address transmitter 74, ~~judgement~~

a judgment part 75, an address agreement information receiver 77, an address change information composition part 78, and an address change information transmitter 79.   Here, the communication control unit 71, the address determination part 73d, the address transmitter

5   74, and ~~judgement~~ the judgment part 75 are the same as those in embodiment 6, and thus their descriptions are omitted.

Address agreement information receiver 77 receives address agreement information.   Here, the address agreement information receiver 77 may optionally include a receiving device for receiving (e.g.

10   modem or network card).   In this case, the~~a~~ receiving device (not illustrated) is to exist between address agreement information receiver 77 and ~~communication line 3~~the communication line 3.   Also, the address agreement information receiver 77 may be implemented by means of hardware, or software such as a driver for driving the

15   receiving device.

Address change information composition part 78, when the address agreement information receiver 77 receives address agreement information, composes address change information.   Address change information composition part 78 may, for example, generate new

20   address change information or read address change information stored in a given recording medium or the like.

Address change information transmitter 79 transmits address change information composed by the address change information composition part 78.   Here, the address change information

25   transmitter 79 may optionally include a transmission device for transmitting (e.g. modem or network card).   In this case, the~~a~~ transmission device (not illustrated) is to exist between the address

change information transmitter 79 and ~~communication line 3~~<u>the</u>
<u>communication line 3</u>.   Also, <u>the</u> address change information

transmitter 79 may be implemented by means of hardware, or software

such as a driver for driving the transmission device.

5   Next, a description is made for the action of a communication

system, in particular, the action for determining and changing an

address, according to this embodiment.   Fig. 43 is a flowchart showing

the action in which ~~server 7~~<u>the server 7</u>n determines an address.

Here, processes S401 through S404 are the same as those in the

10   flowchart of Fig. 18 in embodiment 6, and thus their descriptions are

omitted.

       (S1201) Address agreement information receiver 77 ~~judges~~
<u>determines</u> whether address agreement information has been received.

If received, the flow goes to S1202; otherwise, returns to S401.

15   (S1202) Address change information composition part 78 composes

address change information.

       (S1203) Address change information transmitter 79 transmits

address change information composed by <u>the</u> address change

information composition part 78 to an information-processing device,

20   and then the flow returns to S401.

       Here, in the flowchart of Fig. 43, the process ends with an

interruption of power off or process end.

       Next, a description is made for the action of the communication

system according to this embodiment, using a concrete example.   First,

25   the data structure in tunnel communication is the same as that in Fig.

5.   In addition, the IP addresses and device identifiers of

information-processing devices and a server are assumed to be the

same as those in the concrete example in embodiment 13. First, the process in which ~~first information-processing device 1~~the first information-processing device 1n and ~~third information-processing device 3~~the third information-processing device 3k start tunnel

5   communication, and after that ~~first information-processing device 1~~the first information-processing device 1n and ~~second information-processing device 2~~the second information-processing device 2n start tunnel communication is the same as that in embodiment 14, and thus its description is omitted.

10   It is assumed that, after ~~first information-processing device 1~~the first information-processing device 1n and ~~second information-processing device 2~~the second information-processing device 2n start tunnel communication, the IP address of ~~first information-processing device 1~~the first information-processing device

15   1n, that ~~first information-processing device 1~~the first information-processing device 1n uses for communication target data in tunnel communication with ~~third information-processing device 3~~the third information-processing device 3k, and the IP address of ~~first information-processing device 1~~the first information-processing device

20   1n, that ~~first information-processing device 1~~the first information-processing device 1n uses for communication target data in tunnel communication with ~~second information-processing device 2~~the second information-processing device 2n, are both "192.168.0.1", and the agreement is detected by detection part 53. Consequently, the

25   address change information transmitter 54 transmits to ~~server 7~~the server 7n, the address "192.168.0.1" of ~~first information-processing device 1~~the first information-processing device 1n and the address

"192.168.0.2" of ~~second information-processing device 2~~the second information-processing device 2n, both used for communication target data in tunnel communication performed between ~~first information-processing device 1~~the first information-processing device

5   1n and ~~second information-processing device 2~~the second information-processing device 2n; and address agreement information including information showing that the address of ~~first information-processing device 1~~the first information-processing device 1n has agreed with an address to be used in other tunnel

10 communication, and device identifying information of ~~second information-processing device 2~~the second information-processing device 2n.

Consequently, the address agreement information is received by address agreement information receiver 77 (S1201). Then, the

15 address change information composition part 78 ~~judges~~ determines that an address used for the communication target data in tunnel communication performed between ~~first information-processing device 1~~the first information-processing device 1n and ~~second information-processing device 2~~the second information-processing

20 device 2n, has agreed with an address used for the communication target data in other tunnel communication, and composes address change information for changing the ~~an~~ address used for the communication target data in tunnel communication performed between ~~first information-processing device 1~~the first

25 information-processing device 1n and ~~second information-processing device 2~~the second information-processing device 2n (S1202). This address change information is assumed to include a direction to add "1"

to the host address.   The address change information is transmitted to
~~first information-processing device 1~~the first information-processing
device 1n and ~~second information-processing device 2~~the second
information-processing device 2n by the address change information
transmitter 79 (S1203).   Address change information transmitter 79
can learn the address of ~~first information-processing device 1~~the first
information-processing device 1n, which is a transmission destination
of the address change information, from the transmission source
address of the address agreement information.   Also the address
change information transmitter 79 can learn the address of ~~second
information-processing device 2~~the second information-processing
device 2n, by using the device identifying information of ~~second
information-processing device 2~~the second information-processing
device 2n, included in the address agreement information, and the
address identifier correspondence information shown in Fig. 11.

The address change information is received by the address change
information receiver 55 of ~~first information-processing device 1~~the first
information-processing device 1n, and the address changing part 56
adds "1" to the IP address "192.168.0.1" of ~~first information-processing
device 1~~the first information-processing device 1n and the IP address
"192.168.0.2" of ~~second information-processing device 2~~the second
information-processing device 2n, according to the address change
information, to changes an address.   Further, address change
information is received by the address change information receiver 63
of ~~second information-processing device 2~~the second
information-processing device 2n, and address changing part 64 of
~~second information-processing device 2~~the second

information-processing device 2 also adds "1" to the IP address "192.168.0.1" of ~~first information-processing device 1~~the first information-processing device 1n and the IP address "192.168.0.2" of ~~second information-processing device 2~~**the second**

information-processing device 2n, according to the address change information, to change an address.   After that, tunnel communication is performed between ~~first information-processing device 1~~the first information-processing device 1n and ~~second information-processing device 2~~**the second information-processing device 2**n, using the changed address.

In this concrete example, the description is made for a case where address change information shows how an address is changed. However, the address change information may show a changed address, and in such a case, the address changing part 56 and others are to change the address of ~~first information-processing device 1~~the first information-processing device 1n and others to those shown by the address change information.

As mentioned above, in the communication system according to this embodiment, when ~~first information-processing device 1~~the first information-processing device 1n detects that two or more addresses are the same ~~agree~~, transmitting address agreement information showing two or more addresses ~~have agreed~~are the same to ~~server 7~~the server 7n enables ~~server 7~~the server 7n to be notified of the address agreement.   After that, ~~server 7~~the server 7n sends address change information to an information-processing device according to the reception of address agreement information, allowing each information-processing device to change an address according to the

address change information.   Consequently, ~~first information-processing device 1~~<u>the first information-processing device 1</u>n and ~~second information-processing device 2~~**the second information-processing device 2**n can perform tunnel communication

5   using the changed address, and can also resolve the address agreement that has occurred in ~~first information-processing device 1~~<u>the first information-processing device 1</u>n.

Here, in this embodiment, namely a communication system according to embodiment 6, the description is made for a case where

10   <u>the </u>first information-processing device is further equipped with <u>the </u>address agreement information transmitter 54 and others, <u>the </u>second information-processing device is further equipped with<u> the </u>address change information receiver 63 and others, and <u>the</u>~~a~~ server is further equipped with<u> the </u>address agreement information receiver 77 and

15   others.   However, also in a communication system in other than embodiment 6, as a result that a server and others are equipped with <u>the </u>address agreement information receiver 77 and others, each information-processing device may change an address according to address change information transmitted from the server, in the same

20   way as in this embodiment.   In a communication system according to embodiments 9 and 12, for example, as a result that a server is equipped with an address agreement information receiver, address change information composition part, and address change information transmitter, when the first information-processing device performs

25   tunnel communication with two or more devices, tunnel communication with two or more devices may be appropriately performed by changing at least one of the addresses if an address used for communication

target data agrees.

In addition, in embodiments 13 through 15, the concrete example describes a case where an address is changed when two addresses <u>are the same</u> ~~agree~~. However, also when three or more addresses <u>are the same</u> ~~agree~~, the same address change process may be performed to

5 resolve the address <u>similar</u>~~l~~<u>ity.</u> ~~agreement~~.

Further, the concrete examples in each above-mentioned embodiment describe a case where first information-processing device receives the device identifier of a second information-processing device

10 from a recording medium. However, first information-processing device may receive the device identifier of a second information-processing device with another means such as input by an input device or reception via a communication line.

In addition, in each above-mentioned embodiment, a single or a

15 plurality of communication control devices capable of NAT function (e.g. router) may exist between a first information-processing device and ~~communication line 3~~<u>the communication line 3</u>, or between a second information-processing device and ~~communication line 3~~<u>the communication line 3</u>. In this case, the communication control device

20 is to perform IP address conversion and others.

In addition, in each above-mentioned embodiment, the description is made for a case where servers 4 and 7 are identified by their IP addresses. However, servers 4 and 7 may be identified by their domain names (e.g. "server.pana.net"). In this case, as a result that

25 the domain name is converted by a DNS server, servers 4 and 7 can be identified.

Further, a protocol for communication performed through

communication line 3the communication line 3 in each

above-mentioned embodiment may be either IPv4 (Internet Protocol

version 4) or IPv6 (Internet Protocol version 6).

In addition, in each above-mentioned embodiments, the

5   description is mainly made for a case where thea device identifier is

shown in numeric characters.   However, a device identifier may be

other characters such as alphabetical characters.

In addition, in each above-mentioned embodiments, each process

(each function) may be implemented by a centralized process with a

10   single device (system) or a distributed process with a plurality of

devices.

In addition, in each above-mentioned embodiments, each

component may be composed of dedicated hardware, or software for a

component feasible with software, namely by executing programs.

15   One example is that a software program recorded in a recording

medium such as a hard disk or semiconductor memory is read and

executed by a program executing part such as a CPU, enabling each

component to be implemented.   Here, software for implementing an

information-processing device or server in each above-mentioned

20   embodiment, is the following program.   That is, a program that makes

a CPU execute an address determination step for determining an

address used for communication target data encapsulated in tunnel

communication performed between first information-processing device

and second information-processing device, according to a first device

25   identifier for identifying a first information-processing device and a

second device identifier for identifying a second information-processing

device.

This program may make a computer further execute an identifier accepting step for accepting a first device identifier and/or second device identifier, and may determine at the address determining step an address using the first device identifier and/or second device

5   identifier accepted at the identifier accepting step.

In addition, another program is to make a computer execute a judging step for judging which is a caller or callee, a first information-processing device or second information-processing device, performing tunnel communication; and an address determination step

10   for determining an address used for communication target data encapsulated in tunnel communication performed between a first information-processing device and a second information-processing device, according to a determination by the judging step.

Further, another program is to make a computer execute an

15   address determination step for determining an address used for communication target data encapsulated in tunnel communication performed between a first information-processing device and a second information-processing device, according to a first device identifier for identifying a first information-processing device; a second device

20   identifier for identifying a second information-processing device; and a tunnel communication identifier for identifying tunnel communication performed between a first information-processing device and a second information-processing device.

In addition, this program may further make a computer execute an

25   identifier accepting step for accepting a first device identifier and/or second device identifier, and at the address determining step, an address may be determined using a first device identifier and/or second

device identifier accepted by the identifier accepting step.

Still, this program may further make a computer execute a tunnel communication identifier accepting step for accepting a tunnel communication identifier, and at the address determining step, an

5   address may be determined using a tunnel communication identifier accepted at the tunnel communication identifier accepting step.

Further, another program is to make a computer execute a judging step for judging which is a caller or callee, a first information-processing device or second information-processing device,

10   performing tunnel communication; and an address determination step for determining an address used for communication target data encapsulated in tunnel communication performed between a first information-processing device and second information-processing device, according to a determination by the judging step, and to a

15   tunnel communication identifier for identifying tunnel communication performed between a first information-processing device and a second information-processing device.

In addition, this program may further make a computer execute a tunnel communication identifier accepting step for accepting a tunnel

20   communication identifier, and at the address determining step, an address may be determined using a tunnel communication identifier accepted at the tunnel communication identifier accepting step.

Further, another program is to make a computer execute a process in an information-processing device for communication source

25   performing tunnel communication with two or more devices for communication destination, a program for making a computer execute a detecting step for detecting that two or more addresses <u>are the same</u>

agree that are used for each communication target data encapsulated in two or more tunnel communications; and an address changing step for changing an address used for communication target data when it is detected that two or more addresses are the same agree at the

5   detecting step.

Further, another program is to make a computer execute a process in an information-processing device for communication source performing tunnel communication with a device for communication destination, a program for making a computer execute an address

10   change information receiving step for receiving address change information that is information related to address change; and an address changing step for changing an address used for communication target data.

Further, another program is to make a computer execute a process

15   in an information-processing device for communication source performing tunnel communication with two or more devices for communication destination, a program for making a computer execute a detecting step for detecting that two or more addresses are the same agree that are used for each communication target data encapsulated

20   in two or more tunnel communications; an address agreement information transmitting step for transmitting address agreement information that is information showing address agreement when it is detected that two or more addresses are the same agree; an address change information receiving step for receiving address change

25   information that is information related to address change; and an address changing step for changing an address used for communication target data, according to the address change information.

Further, another program is to make a computer execute: an address agreement information receiving step for receiving address agreement information that is information showing that two or more addresses are the same ~~agree~~ that are used for communication target

5   data encapsulated in two or more tunnel communications; an address change information composing step for composing address change information that is information related to address change so as to resolve the address agreement; and an address change information transmitting step for transmitting the address change information.

10   Here, in the above-mentioned program, the identifier accepting step for transmitting information and other steps do not include a process performed by hardware such as the process performed by an input device or the like (i.e. a process performed only by hardware).

In addition, this program may be executed by being downloaded

15   from a server or the like, or being read from a given recording medium (e.g. optical disc, magnetic disk, or semiconductor memory)

Still, either a single or a plurality of computers may execute this program.   In other words, either a centralized or distributed process may be performed.

20

INDUSTRIAL APPLICABILITY

As mentioned above, in a communication system and others according to the present invention, an address used for tunnel communication between information-processing devices with a simple

25   algorithm, which is useful for a communication system performing tunnel communication, for example.